ARCHIVES OF OTOLARYNGOLOGY

VOLUME 22 AUGUST 1935 NUMBER 2

TREATMENT OF THROMBOSIS OF THE LATERAL SINUS

A SUMMARY OF THE RESULTS OBTAINED DURING TWELVE YEARS AT THE MASSACHUSETTS EYE AND EAR INFIRMARY

PHILIP E. MELTZER, M.D.

BOSTON

This report is the result of a study of the cases of thrombosis or phlebitis of the lateral sinus as reported in the records of the Massachusetts Eye and Ear Infirmary from 1921 to 1932, inclusive. A definite diagnosis was not made until the sinus was opened. The treatment was the same in cases in which merely suspicious findings were present, and for that reason the diagnosis was always recorded as sinus thrombosis. The patients were operated on by various members of the staff. The treatment of the sinus and that of the jugular vein was, with rare exceptions, the same. The procedure consisted of ligation of the jugular vein, free exposure of the lateral sinus and incision and removal of the wall of the sinus and the thrombus, when present, until free bleeding occurred, if possible. The bleeding was controlled by iodoform packs. The packs were also applied in cases in which no thrombus was present. Frequently the wall of the sinus could not be removed when the bleeding was profuse.

The cases were divided into two series; those from 1921 to 1926, inclusive, and those from 1927 to 1932, inclusive. A comparison was made of the two series to determine whether any progress had been made in the diagnosis and management of the disease. As there is no established standard for reporting data on sinus thrombosis I am presenting only the data which seemed of importance to me. No regular attempt was made to compare these findings with the observations of similar cases reported by others. If this were attempted it would lead to a never ending controversy because of the difficulty in comparing the type of cases of one observer with those of another.

INCIDENCE OF SINUS THROMBOSIS AND ANALYSIS OF CASES

From 1921 to 1932, 4,961 mastoid resections were performed, including both simple and radical mastoidectomies, and operations on patients

Presented as a candidate's thesis to the American Laryngological, Rhinological and Otological Society.

who returned with recurrent infection in a mastoid on which an operation had been performed previously. The number of resections was practically equal in the two series. The preoperative diagnosis of sinus thrombosis for the combined series was made in 161 cases (3.2 per cent). The diagnosis was made in almost a third more cases in series 2 than in series 1. This may have been due to the fact that too much conservatism was shown in the first period, or perhaps the diagnosis based only on suspicious findings was made too hastily in the second period. Regardless of what may have been the reason for the diagnosis in the second period, the patients had definite symptoms which were urgent enough to warrant investigation of the mastoid and the sinus.

In each series there were more males than females. The sinus on the right side was involved more frequently than that on the left. This

TABLE 1.—*Analysis of the Cases of Resection of the Mastoid*

	Series 1, 1921 to 1926		Series 2, 1927 to 1932	
	Number of Cases	Percentage	Number of Cases	Percentage
Mastoidectomy	2,496		2,465	
Sinus phlebitis or thrombosis	64	2.5	97	3.9
Males	38	59.4	67	69.1
Females	26	40.6	30	30.9
Right mastoid involved	38	39.4	56	57.8
Left mastoid involved	26	40.6	41	42.2
Acute otitis	48	75.0	58	59.8
Chronic otitis	16	25.0	39	40.2
Recoveries	44	68.7	72	74.2
Fatalities	20	31.3	25	25.8
Recoveries (not including 6 hopeless cases)	44	75.7	72	80.0
Fatalities (not including 6 hopeless cases)	14	24.3	18	20.0
Average number of days of hospitalization				
Patients who recovered	50		35	
Patients who died	35		29	

may have been due to the fact that there were more cases of mastoiditis of the right side.

The acute cases exceeded the chronic cases in considerable numbers in both series. Series 2 showed a definite increase in the number of chronic cases in which a diagnosis of sinus thrombosis was made.

It may be well to state that in the examination of the end-results the percentage of cures compares favorably with the majority of findings reported from large American and European institutions. The percentage can be improved somewhat if the hopeless cases are excluded. The patients who were hopelessly ill on admission in the two series were almost equal in number. Those that died within from one to three days after admission were excluded in the estimation of the percentage of deaths. The patients who died on the fourth or fifth day after admission were included in this summary even though they appeared hopelessly ill when admitted.

Undoubtedly the cases were not as serious as those reported by some of the European clinics, to which the patients often come from

far outlying districts where proper medical treatment is not obtainable. This condition exists infrequently in this country, as shown by the smaller number of cases of intracranial complications with thrombosis as compared, for example, with Mygind's [1] report that in 3,000 cases in which the mastoid was resected, there were 199 cases of sinus thrombosis, of which 53 were associated with abscess of the brain.

The fact that there was a greater number of cases of sinus thrombosis in series 2 and that the patients were in the hospital a shorter period of time may indicate that there was a milder type of disease in this series as compared with that in series 1. Now that the records can be viewed in retrospect it is felt that in a number of cases operation was performed too early and that the patients might have progressed just as well if the sinus had not been opened and the vein had not been ligated. The inclusion of the statistics for the milder cases helps to reduce the average number of days in the hospital for the patients in series 2.

TABLE 2.—*Age Incidence*

Age of Patient, Years	Series 1		Series 2	
	Number of Cases	Percentage	Number of Cases	Percentage
1 to 5	4	6.3	9	9.3
6 to 10	11	17.2	25	25.8
11 to 20	21	32.8	37	38.1
21 to 30	11	17.2	15	15.5
31 to 40	10	15.6	6	6.2
41 to 50	5	7.6	3	3.1
51 to 60	0	0	1	1.0
61 to 70	2	3.1	1	1.0

The age incidence was interesting. The preponderance of cases of thrombosis occurred in patients between the ages of 6 and 30 years, the majority of cases appearing in those between the ages of 11 and 20 years. There were relatively few cases of thrombosis of the lateral sinus in young children as compared with the number of mastoidectomies. The same is true of the elderly patients, but there were also relatively fewer mastoidectomies performed. The infrequency of thrombosis of the lateral sinus in the young may be explained on the basis of the position of the lateral sinus, which plays a less important rôle in relation to the mastoid cells. Therefore, the more probable pathway of infection is from the hypotympanic space into the jugular bulb. On several occasions sinus thrombosis was found in young children who presented no clinical evidence of mastoiditis but merely involvement of the middle ear. It was felt that the infection passed from the tympanic space into the jugular bulb. At the age when the mastoid begins to develop and take form and the sinus becomes well defined in relation to the mastoid cells, there is noted a great increase in the number of cases of thrombosis.

1. Mygind, S. H.: Acta oto-laryngol. **16**:474, 1931.

APPEARANCE OF THE WALL AND CONTENTS OF THE LATERAL SINUS

The records of 57 cases in series 1 and of 87 cases in series 2 contained a full description of the appearance of the wall of the sinus and of the sinus when incised. It is obvious from this analysis that the appearance and palpation of the wall of the sinus give no indication of what may be within it. Some physicians believe that the thrill which is felt when the wall is palpated is an indication that blood is flowing through it. However, this is a difficult sign to elicit when the wall is thickened or when granulation tissue is present. One may see a normal wall in the mastoid cavity and palpation will elicit the thrill of the eddying blood within it, yet there may be a thrombus low down in

TABLE 3.—*Analysis of the Conditions Found When the Lateral Sinus Was Incised*

	Number of Cases	Free Bleeding	Thrombus	Mural Thrombus
Series 1*				
Perisinuous abscess	26	7	16	3
Thickened wall	11	4	7	0
Granulations only	9	5	3	1
Normal sinus	11	5	4	2
Total	57	21	30	6
Percentage		37.7	52.5	10.5
Series 2†				
Perisinuous abscess	44	17	26	1
Thickened wall	14	9	5	0
Granulations only	9	5	1	3
Normal sinus	20	6	12	2
Total	87	37	44	6
Percentage		42.6	50.5	6.9

* Seven incomplete case reports were not included.
† Ten incomplete case reports were not included.

the bulbar region. This observation was made on several occasions. For example, a thrombus was found when the sinus was incised, the free bleeding was controlled by packing and the incision was continued into the bulbar region. Unquestionably, in the presence of a perisinuous abscess one has more reason to suspect the presence of thrombosis or phlebitis. In the two series it was surprising to note the number of proved cases of thrombus in which the wall of the sinus appeared to be normal. I am inclined to believe that when this happens it is the result of a retrograde thrombophlebitis in one of the minute vessels, without definite evidence of necrosis anywhere in the surrounding bone.

OPERATIVE RESULTS AND COMPLICATIONS

In analyzing the proved cases of thrombosis it is noted that of the 36 patients in series 1, 22, or 61.1 per cent, were discharged as well and 14, or 38.9 per cent, died. In series 2, of the 50 patients with a

proved thrombus 35, or 70 per cent, were discharged as well and 15, or 30 per cent, died. In regard to those cases in which there was free bleeding, in series 1 there were 21 cases; 15, or 71.4 per cent, of these patients were discharged as well and 6, or 28.6 per cent, died. In series 2 there were 37 cases of free bleeding. Twenty-seven, or 73 per cent, of the patients were discharged as well and 10, or 27 per cent, died.

It may be mentioned incidentally that there were 141 cases of perisinuous abscess with mastoiditis in which complete exposure of the perisinuous abscess resulted in the abatement of all symptoms and a convalescence without complications. The symptoms were never sufficient to suggest the possibility of the presence of sinus thrombosis.

TABLE 4.—*Postoperative Complications*

	Series 1		Series 2	
	Number of Cases	Fatalities	Number of Cases	Fatalities
Meningitis	9	9	6	6
Abscess of the brain	2	2	6	3
Temporal	2	2	2	1
Cerebellar	0	0	2	0
Parieto-occipital	0	0	1	1
Occipital	0	0	1	1
Labyrinthitis	1	0	1	0
Extradural abscess	4	0	7	0
Facial paralysis	1	0	2	0
Gradenigo syndrome	0	0	2	0
Pneumonia	1	0	5	0
Pulmonary infarction	1	0	1	0
Multiple pulmonary abscesses	0	0	1	0
Empyema of the chest	0	0	3	0
Perinephritic abscess	1	0	0	0
Acute hemorrhagic nephritis	1	0	3	0
Osteomyelitis of the femur	1	0	1	0
Osteomyelitis of the humerus	0	0	1	0

The variety of complications associated with sinus thrombosis may be divided into intracranial and other types. By complications is meant some condition that is directly associated with the aural infection.

Signs of Meningeal Involvement.—In all the cases of meningitis in which organisms were found in the spinal fluid the patient died. In 6 cases of meningitis the following signs were present: cloudy fluid under pressure, stiffness of the neck, a positive Kernig sign and other indications of meningeal irritation, but the spinal fluid showed no organisms, the sugar content was not reduced, and the Pandy test was negative. However, from the elevation of the temperature and other clinical signs there was sufficient evidence to warrant a suspicion of meningitis. These patients all recovered. It is interesting to note that there were only 6 of these cases in the two series. For a long time the impression has been received that these meningeal signs occur more often in proved cases of thrombus, particularly if the thrombus is infected and has extended to the inner or cerebellar wall of the lateral

sinus. There is no question that the signs of meningeal involvement occur, but they are not as frequent as has been suspected. In the absence of definite intracranial complications but in the presence of such signs, when no organisms are found in the spinal fluid, one must continue to examine the sinus for the cause of the symptoms.

Abscess of the Brain.—In series 2, 3 patients with abscess of the brain recovered. Considering the small number of cases of abscess of the brain complicating sinus thrombosis it would seem that the cases have been benign, but this can hardly be the answer since many of the patients with mastoiditis were seen early and were under continued observation. The argument of those who favor early treatment of mastoiditis with signs and symptoms pointing to infection or involvement of the lateral sinus deserves careful consideration. I say this reservedly, because there are always some physicians who need little encouragement to induce them to perform a ligation and an incision of the sinus.

Labyrinthitis.—Sinus thrombosis complicated by labyrinthitis was rare in the present series; it occurred only twice and both patients recovered.

Extradural Abscess.—Extradural abscess with sinus thrombosis also proved to be an infrequent complication, for there were only 11 cases. From the records it is seen that perisinuous abscess occurred much more frequently than extradural abscess, in the ratio of four to one. The only explanation that I can give of the frequency of perisinuous abscess as compared with that of extradural abscess is that there is a much richer vascular connection between the lateral sinus and the mucosa of the mastoid cells than there is between the mastoid cells of the tegmen and the dura. This explanation has reference only to extradural abscess as compared with perisinuous abscess in which the tegmen is intact or the sinus plate is intact, that is, to conditions in which there has been a retrograde thrombophlebitis into these areas. The other types of extradural abscess or perisinuous abscess, which are due to the breaking down of cells which ultimately involve the tegmen or sinus plate, need no further explanation. In the two series there were only 48 cases of epidural abscess in 4,961 cases of mastoid resections.

Infection of the Wound in the Neck.—The wound in the neck resulting from the ligation of the vein became infected in about 40 per cent of cases. Evidence of this appeared in two or three days and as late as in from ten to fourteen days. Some surgeons were of the opinion that the infection was the result of a disintegrated clot in the lumen of the vein above the ligature, but a clot formed only rarely. In the majority of cases it was due to the operative procedure with secondary invasion of the soft tissues.

The other complications as listed are self-explanatory.

Metastasis.—In series 1 metastasis occurred in 21.8 per cent of cases, and in series 2, in 31 per cent. It was far more commonly present in cases of acute otitis than in cases of chronic otitis and it occurred more frequently in those cases in which there was a thrombus. Metastasis appeared with much greater frequency, in fact about four times as often after ligation as before it. The most common complication in cases of sinus thrombosis unquestionably was involvement of the joints.

TABLE 5.—*Incidence of Metastasis*

	Series 1		Series 2	
	Number of Cases	Percentage	Number of Cases	Percentage
Metastasis	14	21.8	30	31
Acute otitis	12		22	
Chronic otitis	2		8	
Metastasis before ligation	3	21.4	7	23.4
Metastasis after ligation	11	78.6	23	76.6
Recoveries from acute otitis	9	71.4	19	73.2
Recoveries from chronic otitis	1		3	
Fatal cases of acute otitis	3	28.6	3	26.7
Fatal cases of chronic otitis	1		5	

TABLE 6.—*Analysis of the Conditions Found When the Lateral Sinus Was Incised in Cases of Metastasis*

Findings	Number of Cases	Thrombus	Free Bleeding	Metastasis: Before Ligation	Metastasis: After Ligation
Series 1*					
Perisinuous abscess	9	5	4	2	7
Granulations or thickened wall	3	3	0	1	2
Normal	2	1	1	0	2
Total	14	9	5	3	11
Series 2†					
Perisinuous abscess	15	10	5	3	12
Granulations or thickened wall	8	6	2	2	6
Normal	7	5	2	2	5
Total	30	21	9	7	23

* Metastases were reported as follows: hip, 7 cases; ankle, 5; shoulder, 5; knee, 3; kidney, 2; elbow, 1; sternum and clavicle, 1; lung, 1, and femur, 1.

† Metastases were reported as follows: hip, 7 cases; chest, 6; ankle, 5; knee, 3; elbow, 3; kidney, 3; sternum and clavicle, 2; foot, 2; thigh, 2; shoulder, 1; arm, 1, and scapula, 1.

All joints seemed to be vulnerable—the hip, ankle, knee, shoulder and others in order of relative frequency. Many of these metastatic foci required surgical drainage. In 6 patients in series 2 one or more foci were operated on and in series 2 surgical drainage was necessary in 10 cases. Metastasis as a complication of sinus thrombosis, though not of grave consequence, adds to the seriousness of the condition.

It was noted that several patients in each series had metastasis before as well as after ligation. Seven patients in series 1 had a single metastatic focus, and 7 had multiple foci, more than two or three

areas being involved. In series 2, 19 patients had a single metastatic focus and 11 had multiple foci, one having as many as four. In 3 of the patients in series 1 metastasis was present before ligation, while in 2 the foci developed after ligation, so that 13 of the 14 patients had metastasis after ligation. Of the 7 patients in series 2 who had metastasis before ligation, 3 had foci after the vein was tied, so that of the 30 patients 26 actually had metastasis after ligation.

Accidental Injury to the Sinus.—There were 6 cases of accidental injury to the lateral sinus which gave rise to a condition requiring ligation of the jugular vein and incision of the sinus. At the time of injury the wall of the sinus was normal in 4 and superficially infected in 2 cases. There was free bleeding in all cases. Metastasis did not occur in any of these cases. One patient died, and it is reasonable to assume

TABLE 7.—*Analysis of Fatal Cases*

	Total No. of Fatal Cases	Chronic	Acute	Thrombus		Free Bleeding	
				Chronic	Acute	Chronic	Acute
Series 1							
Meningitis	9	3	6	2	5	1	1
Septicemia	8	1	7	0	5	1	2
Abscess of the brain	2	1	1	1	1	0	0
Pulmonary embolism	1	0	1	0	0	0	1
Totals	20	5	15	3	11	2	4
Percentage		25	75				
Series 2							
Meningitis	6	5	1	3	0	2	1
Septicemia	11	7	4	4	2	3	2
Abscess of the brain	3	1	2	1	2	0	0
Pulmonary complications	5						
Pneumonia and empyema		2	0	2	0	0	0
Pneumonia		0	2	0	1	0	1
Multiple abscesses		1	0	0	0	1	0
Totals	25	16	9	10	5	6	4
Percentage		64	36				

that death was due to the accident as there was no evidence of septicemia before the injury. On the other hand, it cannot be said with certainty that sepsis would not have developed postoperatively. During this twelve year period the wall of the sinus was injured in several cases, but there was no indication that the trauma was harmful; the patients were free from symptoms and convalesced in the usual manner. In one case a cerebellar abscess developed and drainage through the posterior wall of the sinus was followed by recovery.

Fatalities.—One would expect that sepsis in cases of chronic otitis media would be more serious than in cases of acute otitis, because more severe complications occur in the chronic cases. In series 2 there were 16 fatal cases of chronic otitis as compared with 9 of acute otitis. The figures were reversed in series 1, the fatalities in cases of acute otitis greatly exceeding those in cases of chronic otitis. When septicemia is

complicated by metastatic foci the prognosis is graver; for instance, in series 1 metastasis was present in 4 of the 20 fatal cases and in series 2 in 8 of the 25 fatal cases.

DIAGNOSIS OF SINUS THROMBOSIS

Boies [2] described three types of sinus thrombosis in a review of the records at the Massachusetts Eye and Ear Infirmary: (1) manifest sinus thrombosis with symptoms of thrombosis or phlebitis at the time of operation, (2) latent sinus thrombosis in which no indication was given that a thrombus was present until several days after mastoidectomy was performed and (3) postoperative sinus thrombosis, which was probably due to simple mastoidectomy, wherein an exposed sinus in contact

TABLE 8.—*Length of Time Between Mastoidectomy Ligation and Opening of the Sinus*

Number of Cases	0 to 2 Days	3 to 7 Days	8 to 14 Days	15 Days or Longer
Series 1				
Thrombus	20	8	6	2
Free bleeding	6	7	6	2
Incomplete data	2	1	2	2
Totals	28	16	14	6
Series 2				
Thrombus	38	9	1	2
Free bleeding	22	9	4	2
Incomplete data	5	3	0	2
Totals	65	21	5	6

with infected secretions during convalescence became infected, thereby favoring the formation of a thrombus.

From my analysis of the records I have gained the impression that sinus thrombosis is an infrequent postoperative complication and that latent sinus thrombosis occurs more frequently. The number of cases in which a diagnosis of sinus thrombosis was made at the time of the initial operation far exceeds the number of cases of other types in which a diagnosis was made.

There is always the danger of error in diagnosis when one tries to complete the entire operative work on the same day because of the presence of a high temperature and a chill. These symptoms may be nothing more than indications or warnings that infection is present. Evidently these symptoms occurred frequently in the patients in series 2 and were promptly treated, as shown by the large number of cases of free bleeding as compared with the number of proved cases of thrombus in this series.

2. Boies, L. R.: Ann. Otol., Rhin. & Laryng. **41**:227 (March) 1932.

Ayer-Tobey Test.—The Ayer-Tobey test was found to be correct in from 75 to 80 per cent of cases. In series 1 there were only 11 reports as this test was just coming into use at that time. In series 2 53 tests were made. In series 1 the manometer readings were completely verified in 72.7 per cent of cases and partly verified, in that mural thrombus was found, in 9.1 per cent. The test was a complete failure in 18.2 per cent of cases. In series 2 the manometer readings were verified in 64 per cent, partly verified in 9 per cent and a failure in 27 per cent of cases. This test continues to be one of the best diagnostic aids in cases of thrombosis of the lateral sinus.

Blood Cultures.—I feel that when the blood culture gives a negative result operation should not be postponed, particularly if the symptoms are of such proportion that investigation of the sinus is indicated. If the patient is not losing ground consistently, negative cultural results warrant only conservative action. A positive result of culture before mastoidectomy is of value in that it points to invasion of the blood stream, occurring most likely through the lateral sinus, and immediately calls attention to that region. On the other hand, immediate action on the lateral sinus is not recommended simply because a blood culture gives a positive result.

In this analysis I am utilizing only the reports of blood cultures in the cases in series 2. For 65 patients a complete analysis of the blood was made, from two to six cultures being studied for each patient. The blood cultures gave negative results before ligation in 50 cases; in 13 cases the results became positive after ligation, which seems to indicate that tying the vein did not prevent bacterial invasion of the blood. Surprising as it may seem, in the 50 cases in which negative results were obtained before ligation, 30 of the patients were found to have a thrombus.

TREATMENT

The procedures recommended for the treatment of patients with sinus thrombosis vary greatly, and yet the adherents of each method claim an approximately equal percentage of cures. If this is true, is it not reasonable that the procedure should be used which involves the minimum surgical intervention? From the records it is seen that the majority of undesirable complications occurred after ligation. Although ligation seemed to do no harm, it certainly could not be proved to aid the patients. Why, then, add ligation to the surgical treatment of infection of the lateral sinus? There is always the risk of the development of a secondary infection in the wound in the neck as well as of injury to the vein and nerves in that region. These structures have been injured even by the most competent technicians.

I feel that the thrombus should not be completely removed. It is imperative that all diseased bone overlying the sinus should be removed,

the operation being carried into the deepest confines of the mastoid if necessary. The wall of the sinus should then be incised and as much of it removed as possible. The midportion of the clot should be cleaned out sufficiently to expose the inner wall of the sinus, the area being lightly packed with iodoform gauze and the mastoid cavity left open for drainage. If the clot is too small to permit this procedure, it should be exposed without establishing free bleeding and packed. Should free bleeding occur in a case in which a thrombus was expected to be found, there is little that can be done except place the iodoform packs over the incision to control the bleeding. Further treatment then depends on the symptoms.

Obviously, a hard and fast rule for treatment in all cases of sinus thrombosis cannot be laid down. The signs and symptoms should be evaluated and the patient treated as the occasion demands. One has no right to assume that the worst may happen if the treatment is conservative. The indications for extreme radical procedure in the present series were rare, and when operation was performed it failed to influence the outcome. In the event of a fatality, if reasonable care has been exercised, the surgeon should not be troubled because he did not carry out every known surgical procedure. The end-result is largely due to the ability or inability of the patient's resistance to cope with the virulent infection.

It must be added that the comments made in this review, particularly in regard to treatment, do not represent the consensus of the members of the staff of the Massachusetts Eye and Ear Infirmary. They are entirely personal opinions. Further, I do not wish to give the impression that the treatment which is advocated is in any way original; it has been proposed for many years by numerous surgeons in this country and abroad. It may vary a little in detail but the fundamental principles are unchanged.

I also wish to state that undoubtedly there will be a rare case in which treatment of the jugular vein is demanded, and I should not hesitate to treat the vein if the proper symptom were presented.

SUMMARY

Symptomatically it is impossible to distinguish between sinus thrombosis and phlebitis.

In a total of 4,961 cases of resection of the mastoid the diagnosis of sinus thrombosis was made in 161 cases, indicating that it occurred once in approximately 31 cases. Sinus thrombosis is the most frequent complication of mastoiditis, the greater number of cases occurring in association with acute otitis. It occurred more often in patients between 11 and 20 years of age, the curve of incidence tapering off sharply at both extremes of age.

Metastasis was an uncommon complication before ligation of the jugular vein. Involvement of the joints was the most common complication, the greatest number of cases occurring after ligation and treatment of the sinus. Involvement of the joints adds to the seriousness of the disease as it may prove to be the focus which continues to feed organisms into the blood stream.

Blood cultures are of value as an aid in establishing a diagnosis or at least in focusing attention on the lateral sinus. In the presence of continuing symptoms negative results of blood cultures should not contraindicate examination of the sinus.

The Ayer-Tobey test is a valuable diagnostic aid. The reliability of the test is dependent on the experience and carefulness of the person making the test.

The records bear out definitely the common knowledge that the appearance of the sinus gives no indication of what may be within it. One has more reason however to suspect injury to the endothelial lining in cases in which there is a perisinuous abscess.

Sinus thrombosis is not necessarily fatal if not treated surgically. Operation is always indicated, in my opinion, as the best means of aiding the patient to overcome the infection, affording drainage which thereby tends to limit the disease. Extirpation of the focus of disease is an impossibility; the surgeon merely aids the patient. The battle for supremacy is between the infecting organism and the patient's power of resistance.

Postoperative sinus thrombosis occurs infrequently as compared with the manifest and latent types of thrombosis.

Secondary infection of the wound of the neck occurs fairly commonly.

The percentage of fatalities in general may be considered to be between 20 and 30 per cent. In this report the patients who were hopelessly ill on admission were excluded. In the combined series there were 148 patients, of whom 32, or 21.7 per cent, died and 116, or 78.3 per cent, recovered. Excluding intracranial disease sinus thrombosis must be considered to have a relatively high mortality rate.

RADICAL MASTOIDECTOMY IN ADULTS WITH AURAL TUBERCULOSIS AND ACTIVE PULMONARY TUBERCULOSIS

IRVING MUSKAT, M.D.
CHICAGO

INDICATION FOR OPERATION

Surgical intervention for the patient with active pulmonary tuberculosis has always been looked on as a grave detriment because of the low body resistance, and the fundamental treatment relied on has been based on the general building up of this resistance. The main trend of this thought has not changed today, but in the past few years physicians treating patients with pulmonary tuberculosis have learned and accepted the value of surgical procedures, such as thoracoplasty, injection of gas and phrenico-exeresis, in helping the body fight its disease with greater success than before. The value of surgical treatment has extended to other tuberculous conditions and complications. Thus, no one will gainsay the value of the use of cautery puncture in treating a tuberculous epiglottis, nor can one deny the value of resection of the superior laryngeal nerve for the control of incessant dysphagia due to a tuberculous larynx, the relief of which by this means insures the patient sufficient sleep and food. Excellent results from these methods have given me courage to work in a related field. This field is the eradication, with the use of local anesthesia, of tuberculosis of the mastoid in patients with active pulmonary tuberculosis.

Since the first clinical recognition of tuberculosis of the mastoid by Wilde [1] in 1853, considerable work has been done relative to the diagnosis, pathologic characteristics and treatment. As its presence was so frequently associated with active pulmonary tuberculosis, the treatment of tuberculosis of the mastoid consisted of conservative general and local measures. However, many cases have been reported in which mastoidectomy was demanded because of subperiosteal abscess, facial paralysis, fistula or intracranial complication, some of which were not recognized as cases of tuberculosis because there was no apparent disease of the lungs. Most of these cases occurred in infants and children, although some were in adults, and in most instances a cure was effected.

When the disease of the mastoid was associated with definite, frank, active pulmonary tuberculosis, a more conservative attitude was adopted

1. Wilde, W. R. W.: Practical Observations on Aural Surgery, London, J. & A. Churchill, Ltd., 1853.

by most authors on the ground that the general low vitality of the patient contraindicated operation on the mastoid. Politzer [2] stated that mastoidectomy yields the most favorable results in cases in which the primary focus of tuberculosis lies in the mastoid process, especially in children, and he further conceded that the operation is indicated in cases of tuberculosis of the middle ear in which the pulmonary involvement is not advanced. He stated: "In such cases we are not only able at times to cure the local process, but also to bring about an improvement in the general welfare of the patient and a cessation of the pulmonary condition. In individuals with advanced phthisis and in tubercular-necrotic processes, the prospects of the operation are poor. When symptoms of mastoid involvement present themselves, it is advisable to operate as early as possible, as long as the strength of the patient gives us some prospect of recovery."

Milligan [3] advised operation when the extent of the disease is not too great and the general condition of the patient not too hopeless. Whenever the question of operation for the eradication of tuberculosis of the mastoid has arisen, the fear of operating on a patient with active pulmonary tuberculosis has loomed in the foreground with the tendency to think that it should not be done.

But none of these authors considered local anesthesia and the control of shock, whereby the diseased focus could be removed with benefit to the patient. I therefore advocate as a general, as well as a local, measure the treatment of tuberculosis of the mastoid and temporal bone by radical mastoidectomy with local anesthesia. The operation eradicates the often present extensive disease, thereby removing a focus which has previously added to the depletion of the recuperative forces of the body by the already existent pulmonary disease and which has no doubt been a factor in many cases in forcing the fatal issue.

The cases which I consider in this paper are instances of chronic tuberculous suppuration of the middle ear with advanced pulmonary disease in which radical mastoidectomy resulted in cure or in control of the local disease and brought about general improvement. They are not cases in which operation was demanded because of subperiosteal abscess, facial paralysis, fistula, cold abscess or intracranial complication. To the casual observer the patient presented merely a discharging ear and the complaint of deafness. But the usual history of a painless onset and the infrequency of complications so often seen in cases of nontuberculous infection have led to the negligence and lack of interest of the physician

2. Politzer, Adam: A Text-Book of the Diseases of the Ear, for Students and Practitioners, ed. 6, Philadelphia, Lea & Febiger, 1926.

3. Milligan, W.: Diagnosis and Treatment of Tuberculous Disease of the Middle Ear and Accessory Cavities, J. Laryng., Rhin. & Otol. **18**:137, 1903.

in the study of such cases of tuberculous disease of the middle ear. Therefore, unless he acquaints himself with the pathologic condition, he is unaware of what is going on in a mastoid of this type, and he cannot begin to realize its effect on the general health of the patient. A chronically discharging ear is a drain on the vitality of the patient, without consideration of the added effect of decreasing hearing and the possibility of an acute exacerbation with fatal intracranial complications. But let me open the mastoid of a patient with an apparently innocent discharge from the ear and point out the wide tuberculous destruction, and its effect on the patient will be realized. If then this added focus of absorption of tuberculous toxins is removed without jeopardizing the general health of the patient by a mastoidectomy, one is justified in doing so. In this case there is a grave tuberculous focus which, unlike that of the lung, can be removed by safe surgical measures. If the patient, moreover, improves in health, the ear stops discharging, the possibility of fatal intracranial complication is removed and the progress of the decrease in hearing is checked, there can be no question of the worth of the measure. Furthermore, a patient who fares badly after such a radical mastoidectomy, performed when he is under local anesthesia and prepared to withstand operative shock, will not survive the pulmonary infection. Politzer and the workers who have adhered to the contraindications he advocated have not considered the operation with the patient under local anesthesia, which gives it an altogether different aspect.

CLINICAL SYMPTOMS AND PATHOLOGIC CHARACTERISTICS OF TUBERCULOSIS OF THE MIDDLE EAR AND MASTOID

Tuberculosis of the middle ear was recognized and described as a definite entity before the discovery of the tubercle bacillus by Koch in 1882. Politzer [2] cited the progress made in observations on tuberculous infections of the middle ear. Thus, he mentioned that Wilde in 1853 called attention to the clinical picture of tuberculous inflammation of the middle ear, to its painless onset and to the character of the discharge. Politzer described the clinical peculiarities of this condition in 1865, and Schwartze described the seldom occurring, cheesy infiltration of the mucous membrane and the presence of tuberculous nodules on the drum membrane, which are usually associated with rapid destruction of the tympanic membrane. Later in 1882 Politzer published his observations on the histologic structure of the mucous membrane of a tuberculous middle ear in a patient who had died of phthisis. A portion of the mucous membrane of the promontory had been destroyed by the tuberculous process, and the disease had also extended into the bone. These observations are of significance to the clinical picture and to the operative disclosures in the cases considered in this presentation.

The clinical picture and the course of tuberculosis of the middle ear are characteristic. On close examination the earliest symptom often noted is a sense of fulness in the ear and deafness, but the occurrence of the discharge with its painless onset is the most frequent complaint. As stated by Mathews,[4] the absence of pain is not peculiar to this condition but is found in any case of tuberculous osteomyelitis prior to the involvement of the surrounding structures or the advent of mixed infection. He expressed the belief that a painless onset of a chronic discharge from the ear justly raises the suspicion of tuberculosis. Spencer [5] rightly called attention to the observation that the presence of pain preceding the discharge is nearly always due to mixed infection and that the amount of pain is in proportion to some extent to the predominance of the pyogenic organisms. I agree with these observations as well as with those of Chapman,[6] who stated that tenderness of the mastoid is rare but may occur in the presence of a mixed infection.

In a case reported by Robinson [7] the patient experienced tinnitus but no pain before the discharge. My observations are fully in accord with those of Thomson,[8] who has had wide clinical experience in cases of tuberculosis of the ear, nose and throat. He stated: "In all cases the most striking symptoms are the absence of pain, fever, or free discharge. The patient first complains only of deafness or a dull sensation in his ear. The early and rapid onset of deafness is very marked. It may even happen that the first thing to attract the patient's attention is some moisture or a slight discharge. There is no throbbing, distention or tenderness."

OTOSCOPIC FINDINGS

Chronicity of the aural discharge is an essential feature. It may be watery or, more often, curdy, thick, creamy and pultaceous but is never blood-stained. The discharge has a sickly or fetid odor and forms a thick pultaceous, gray-yellow, often semitranslucent film against the drum membrane, concealing its landmarks. When the secretion is removed from the posterior canal, the perforation through which it has escaped is often filled and concealed by a thick, white, curdy or trans-

4. Mathews, P.: Tuberculosis of the Middle Ear in Children, with Special Reference to Its Occurrence as a Primary Lesion, Ann. Otol., Rhin. & Laryng. **16**:390, 1907.

5. Spencer, F. R.: Tuberculosis of the Middle Ear, Arch. Otolaryng. **6**:242 (Sept.) 1927.

6. Chapman, S. J.: Tuberculosis of the Middle Ear, with Especial Reference to Heliotherapy, Ann. Otol., Rhin. & Laryng. **36**:631, 1927.

7. Robinson, J. A.: Tubercular Otitis, Ann. Otol., Rhin. & Laryng. **24**:363, 1915.

8. Thomson, St. Clair: Tuberculosis of the Middle Ear, as Met with in Adults in a Sanatorium, J. Laryng. & Otol. **46**:460 (July) 1931.

lucent discharge from the middle ear. As a rule the discharge is not profuse, unless there is extensive destruction of the petrous bone.

The appearance of the drum varies at different stages. Very early one may be able to see thickening of the drum membrane, which is injected, with obliteration of all landmarks, followed in a week or ten days by the appearance of one or two tubercles which undergo necrosis with perforation of the drum. The finding of these tubercles is pathognomonic. Most authors describe multiple perforations, but I have seen this condition in but one case, even after following the course from the beginning in several instances. That it may occur is without question, although Thomson [8] in his twenty-five cases observed double perforation only twice. Leegard,[9] in a report of twenty-five cases, observed multiple perforation but once, while in one hundred and eighty cases of nontuberculous conditions it was observed five times. He stated: "We explain the opinion that multiple perforations are common in tubercular otitis by the fact that until recent years, we have failed to recognize this disease in cases other than phthisical subjects."

These perforations are, as a rule, two in number, one of which is usually in the anterior inferior quadrant and one in the posterior inferior quadrant. As a rule, the lesion starts as a very small circular opening—in my case as a stellate hole in a thickened and reddened membrane—which soon enlarges and becomes irregular. Ormerod,[10] in his series of seventeen cases of adults, observed double perforation in eight patients, one of whom had the condition in both ears. He explained the site of these perforations by the arrangement of the blood supply of the drum membrane. References to multiple perforations may be found in many articles on tuberculous otitis, but unless the clinician watches for them early at the time the patient comes to him he does not see them. The single perforation varies in size and location and is often peripheral, depending, I presume, on the severity and duration of the infection, the previous condition of the ear and whether the infection is by way of the blood stream or the eustachian canal, as well as on the effect of the secondary pyogenic contamination. At this point I might draw attention to the fact that multiple perforations occur in syphilis as well and, further, that tuberculosis and syphilis often occur together.

Another feature, that of pale, flabby granulation tissue, is stated by most writers to be a frequent, characteristic finding in tuberculous diseases of the middle ear. There is no question that it occurs, as I have noted such granulations often in my patients, but frequently no marked

9. Leegard, F.: Tuberculosis of the Middle Ear, Laryngoscope **31**:374 (June) 1921.

10. Ormerod, F. C.: Tuberculous Disease of the Middle Ear, J. Laryng. & Otol. **46**:449 (July) 1931.

reaction of granulation tissue is found. At times these lesions are injected and not pale and flabby. However, as pointed out by Leegard [9] and others, tuberculosis is associated with abundant and rapidly recurring granulations in cases of acute and subacute otitis, while in chronic cases the pressure, color, consistency, etc., of the granulations are of no diagnostic value. Spencer [5] expressed the belief that the granulations may be scanty or abundant and pale and flabby, while acute exacerbations and hemorrhage may for a time produce red granulations and more pus.

FACIAL PARALYSIS

The conception of the frequency and significance of facial paralysis has also undergone revision in respect to its relationship to tuberculosis of the middle ear. I do not believe that in the adult it is more frequent in tuberculosis than in pyogenic infections of the middle ear and mastoid, but when it occurs in association with other symptoms, such as painless onset and rapid deafness, it further justifies the suspicion of tuberculous. Graham,[11] in discussing the pathologic types of tuberculosis of the mastoid, expressed the belief that facial paralysis occurs more often in cases of rapid erosion of the bone in the necrotic form and of invasion of the tissues in the infiltrative form. If that observation is correct these are not the types usually seen in the adult. I observed a case of paralysis of the facial nerve only once. Ormerod [10] encountered facial paralysis in only one case and explained its infrequency on the ground that in the adult extension from the middle ear is rare and mastoiditis is met only rarely. However, in all the cases considered in this paper involvement of the mastoid was a marked feature, although I observed only one instance of facial paralysis in the series, including all cases of tuberculous disease of the middle ear. Leegard [9] encountered no case of facial paralysis in a series of twenty-five. Regarding this complication he stated: "I think you will find that most other writers who reported a frequency of facial paralysis in tuberculous otitis media have examined either patients in the advanced states of pulmonary tuberculosis or infants and small children suffering from some fatal form of tuberculosis. My conclusions are that facial paralysis is to some degree characteristic of grave cases, but in general this sign is not common. In other words, it is more significant as regards the prognosis than in the diagnosis." I might add that the mastoiditis is "silent," and one is not aware of the involvement because of the absence of pain. In children, however, mastoiditis is more often recognized because of the frequent complication of subperiosteal abscess and facial paralysis. This is in accord with the observations of Leegard

11. Graham, H. B.: Tuberculosis of the Middle Ear, Ann. Otol., Rhin. & Laryng. **25**:105 (March) 1916.

that seven of the nine cases of children between 7 and 9 years old, the age at which the incidence of tuberculous otitis media is high, were complicated by mastoiditis.

DYSFUNCTION OF THE EAR

The rapid decrease in hearing and the involvement of the labyrinth are important signs characteristic of tuberculous disease of the middle ear. The decrease in hearing is one of the earliest signs and rapidly becomes pronounced, indicating by its severity inner ear as well as middle ear deafness. In the early stage the deafness is of the conduction type, but soon the perceptive involvement becomes markedly evident. One is struck, as Graham [11] pointed out, with the disharmony between the marked deafness and the length of time and severity of infection. With the involvement of the cochlea the labyrinth becomes diseased, often to a marked degree, as revealed by functional tests. With this gradual invasion no acute labyrinthine storm, with its spontaneous nystagmus or labyrinthine ataxia, occurs.

There is, as a rule, no history of labyrinthine storms, even though the functional tests show marked, or even total, loss of labyrinthine irritability. Occasionally, a history of marked tinnitus and vertigo is noted, but this is exceptional. Labyrinthine deafness, as shown by functional tests, remains after the control and eradication of the tuberculous process in the mastoid and middle ear. Of course, this is to be expected. Pathologically, these observations can be accounted for at operation or at autopsy. In some of the cases in this study marked thickening of the external promontory, replacing the shiny, smooth surface was seen. There was no sharp demarcation of this landmark from the surrounding inner wall of the middle ear. That invasion of the labyrinth is not of uncommon occurrence, especially in children, is evident from the reports of the pathologic condition by other observers. Thus Turner and Fraser [12] noted necrosis of the labyrinth, in part or in its entirety, in a large proportion of young children with tuberculous mastoiditis undergoing operation in their clinic. I have not met the necrosing form of tuberculosis of the temporal bone in adults, but it may occur. Ruttin [13] reported a case in which a conservative operation on the mastoid revealed extensive disease of the bone. After a month headache, facial paralysis, marked decrease in hearing and retraction of the head without the usual signs of meningitis occurred, while on further exploration no intradural abscess was noted. The patient died, and autopsy

12. Turner, A. L., and Fraser, J. S.: Tuberculosis of the Middle Ear Cleft in Children: Clinical and Pathological Study, J. Laryng. & Otol. **30**:209, 1915.

13. Ruttin, E.: Zur Klinik und Pathologie der tumorartigen Tuberkulose des Felsenbeins, Ztschr. f. Hals-, Nasen- u. Ohrenh. **14**:217, 1926.

revealed tuberculous caries of the petrous bone, tuberculous outgrowths from the labyrinth and internal meatus and involvement of the acoustic nerve. Other reports of pathologic observations may be cited. Deutsch [14] recorded the observation at autopsy of obliteration of the semicircular canals with compact bone and that of the cochlea with spongy bone in a child 3½ years old, who had chronic suppuration of the middle ear, facial paralysis, recurrent headache, complete absence of caloric reaction and subsequent fatal tuberculous meningitis. In a comprehensive article discussing tuberculosis of the labyrinth, Rigaud [15] stressed the insidious invasion of the labyrinth, the torpidity of the evolution of cochlear-vestibular signs, the malignancy of the disease and the frequent implication of the facial nerve and later perhaps of the internal carotid artery and meninges. Such invasion of the labyrinth is always the result of extension from the middle ear. However, as already pointed out, the implication of the facial nerve is a rarity in the clinical cases encountered.

LABORATORY FINDINGS

The finding of the tubercle bacillus in the secretion of the middle ear, together with the characteristic clinical history and findings, establishes the fact that the infection of the middle ear is tuberculous. In many of my cases tubercle bacilli were found by examination of slides stained with carbolfuchsin and acid alcohol. The great frequency with which tubercle bacilli are found on smears is no doubt the result of open active lesions of the lungs with bacilli in the sputum which finds its way through the eustachian canals during expectoration. However, it must be remembered that the failure to find bacilli on the smears, which is often difficult, does not constitute proof that the patient is not tuberculous. Even the culture of material from the secretions demands special mediums and care. In this connection I may refer to the article by Cox and Dwyer.[16] The value of inoculation of guinea-pigs in cases in which cultures and smears are negative should be mentioned.

But in spite of confirmation by laboratory examination, which should be made, the clinical findings and the picture of the ear itself constitute the factors of greatest value in the diagnosis. Occasionally one is confronted with tuberculous infection of the middle ear superimposed on a preexisting pyogenic infection. When the smears are positive opera-

14. Deutsch, L.: Zur Histologie der tuberkulösen Labyrinthitis, Ztschr. f. Hals-, Nasen- u. Ohrenh. **12**:565, 1925.

15. Rigaud, P.: La tuberculose du labyrinthe, Ann. d'oto-laryng. **50**:634 (June) 1931.

16. Cox, G. H., and Dwyer, J. G.: Tuberculosis of the Middle Ear, Arch. Otolaryng. **9**:414 (April) 1929.

tion may be advised. When the secretion reveals no tubercle bacilli in the cases of pyogenic infection, the question of operation must be decided on the basis of the clinical findings alone. The finding of tubercle bacilli may be a difficult task also when pyogenic infection follows a tuberculous process, but in this case the painless onset and the marked loss of hearing and other findings leave little doubt as to the etiology.

Roentgenography may be of value in determining the amount of destruction of the mastoid in a given case. It also may disclose other valuable information. Thus, sclerosis of the mastoid, the result of past pyogenic infection of the middle ear or of arrested pneumatization of the mastoid, may constitute a reason for not operating on a patient who is very ill with pulmonary tuberculosis, on the ground that the disease of the middle ear is not extensive in cases of sclerosis of the mastoid. Sequestrums may be evident in the roentgenogram.

COMPLICATIONS OF MENINGITIS

Whenever there is invasion of the labyrinth the possibility of fatal meningitis arises. That this condition develops at times in cases of tuberculosis of the ear, with or without or after mastoidectomy, is evident from several reports. Thus, Turner and Fraser [12] noted necrosis of the labyrinth, in its entirety or in part, in eight of the thirty-five patients (children) operated on for tuberculous mastoiditis in their clinic. They observed tuberculous meningitis in two, or 5 per cent, of the cases in which operation was performed. This is not astounding when it is recognized that in fulminating or in chronic forms of tuberculosis of the bone, especially in children, marked destruction of the bone with sequestration may occur. It is also interesting to note that Cox and Dwyer [16] reported that two of twenty-five patients with aural tuberculosis on whom no operation was performed died of meningitis. The case of a patient without evidence of pulmonary disease who died of meningitis, supposedly tuberculous, after operation on a mastoid which proved to be tuberculous was recorded by Tawse.[17]

But these observations do not establish a contraindication to radical mastoidectomy in cases of tuberculous involvement of the temporal bone in which if disregarded the condition might progress and cause the death of the patient by virtue of a focus of toxic absorption or by direct extension, producing fatal meningitis, whether tuberculous or mixed. Furthermore, the fact remains that in all my cases there were no deaths from meningitis but, instead, healing of the mastoid and gain in the general health of the patient. The probability of meningitis is, as far

17. Tawse, H. B.: Acute Senile Tubercular Disease of the Left Middle Ear and Mastoid, J. Laryng. & Otol. **44**:255 (April) 1929.

as I can see, no greater than in any other form of mastoiditis. In fact, labyrinthine invasion which is so constant in tuberculous disease, because of replacement by fibrous tissue, seems to me to be a safeguard against meningitis resulting from jarring at operation. When a fistula or sequestrums of the labyrinth are present, their removal may precipitate meningitis, but I have not encountered these conditions in the adult, and I should not disturb them if I did, since nature will do the work in a slower but safer manner under such circumstances.

TECHNIC OF MASTOIDECTOMY

In presenting the value of radical mastoidectomy in the adult patient with active pulmonary tuberculosis I am not unaware of the literature and of the work of other investigators regarding local treatment with heliotherapy, injections of tuberculin, etc. I am not belittling the value of these measures in certain cases, but I cannot see how a ray of light thrown down a narrow canal or a few drops of a solution can cure an extensive tuberculous process beyond the confines of the middle ear, so frequent in these cases. Furthermore, tuberculosis of the middle ear is a chronic infection not only of the mucous membrane but also of the temporal bone, that is, of tissues beyond the confines of the middle ear. Its judicial treatment is, therefore, complete removal of the diseased bone by radical mastoidectomy.

Preparation of the patient is made as follows:

The night before operation 3 grains (194.3 mg.) of sodium amytal is given by mouth to insure a good night's sleep. When the patient arises and again three hours later the dose is repeated. One-half hour before the operation morphine is given subcutaneously. At the operation block anesthesia of the skin around the mastoid with a 1:1,000 solution of nupercaine with epinephrine is effected. The infiltration extends all around the pinna as well as into the posterior wall of the canal under the periosteum. There is no pain until the middle ear is exposed, which is controlled by insertion for a few minutes of a tampon soaked with a 10 per cent solution of cocaine. Under these circumstances shock is reduced to a negligible rôle.

The classic radical mastoidectomy is performed. A meatal flap of the Bondy type is made, followed by packing of the cavity with iodoform gauze which is removed with the stitches in a week. Postoperative treatment consists of daily irrigations of surgical solution of chlorinated soda, followed by drying with alcohol and insufflation with iodine and boric acid or iodoform. Granulations are prevented by applications of silver nitrate.

Epidermization ensues normally, resulting usually in a dry cavity. In some cases there is protracted secretion from the orifice of the eustachian tube, and exacerbations of wet cavities from infections of the eustachian tube have occurred in my cases. The point to remember, however, is that by virtue of a radical mastoidectomy an enclosed tuberculous focus has been obliterated.

SUMMARY OF CASES

This paper was based on the study of twelve cases. All were associated with active, far advanced pulmonary tuberculosis. In eight of the cases direct smears of the aural discharge revealed tubercle bacilli; in two cases the findings were questionable and in two, insignificant. All smears showed mixed infection with diplococci, staphylococci and short and long bacilli.

Facial paralysis existed in only one case.

In nine cases the onset was painless. In two symptoms of tinnitus and dizziness appeared at the onset. In one there was slight pain. In four cases absolute deafness with a dead labyrinth was revealed, but there was a history of labyrinthine storms in only one instance. In all these cases discharge from the ears had been present for less than one year. In the remaining cases a marked decrease in hearing was shown. Evidences of nerve deafness were present in ten cases. Vestibular tests gave normal responses in only three cases.

The conditions noted in the mastoid at operation were as follows: in three cases the mastoid was sclerotic; in all the others marked destruction was revealed. In three cases the lateral sinus and the dura of the middle fossa were exposed and observed to be covered with granulations; in one of these instances the cerebellum itself was exposed. The membrane over the promontory was definitely thickened in four cases.

In nine cases a dry cavity was obtained. In three of these instances there was exacerbation of a wet cavity. In ten cases immediate and rapid gain in weight occurred after operation. Two of the patients died within two weeks of pulmonary tuberculosis. No patient under observation had meningitis before or after operation.

CONCLUSIONS

Tuberculosis of the middle ear and mastoid as seen in the adult with active pulmonary tuberculosis, because of its insidious, painless onset, has not received the attention it merits.

Tuberculosis of the middle ear and mastoid presents an added focus to the pulmonary disease, interfering with the building up of bodily resistance which is essential to control of the disease. The focus in the mastoid, which is often extensive, can (unlike the pulmonary focus) be readily eradicated by the classic radical mastoidectomy performed with local anesthesia. Patients with active pulmonary disease improve in health with the eradication of the focus in the mastoid.

OSTEOMA OF THE FRONTAL SINUS

REVIEW OF THE LITERATURE AND REPORT OF A CASE PRESENTING EXTENDED INVASION OF THE ORBIT

WILLIAM LAWRENCE GATEWOOD, M.D.
AND
NATHAN SETTEL, M.D.
NEW YORK

Osteoma of the frontal sinus, once rated as an extremely rare finding, has been demonstrated under modern diagnostic methods in a fairly large series of cases. Its interest, however, is in no wise diminished but is rather increased by the revelation of its greater incidence. Despite vast improvement in the surgical handling of such growths, much remains to be learned concerning the best method of treatment. The diagnosis is still difficult, and often long delayed, and the fear of facial disfigurement influences the patient to put off operation as long as possible. All these factors make the accumulation of clinical reports and records of improvement in operative technic extremely important.

HISTORY

Osteoma of the frontal bone has been recognized since ancient times. The growths occur not only in man but in animals as well, particularly in bovines and other ruminants, possibly bearing some relation to the normal horny formations in these creatures. Dugmore,[1] the naturalist, found in the remote forest of Newfoundland the skeleton of an elk the skull of which showed a huge bony exostosis which had undoubtedly caused the animal's death by pressure on the brain. Medical literature contains several reports on similar growths seen in oxen, sheep and goats. Paget[2] described a specimen from an ox, which can yet be seen in the Museum of the Royal College of Surgeons—"a great spheroidal mass of ivory, measuring 8½ inches in diameter, and weighing upward of 16 pounds."

In 1799 Home[3] gave an account of osteomas of the frontal sinus as they occur in human beings. Subsequent writers in England and

From the Department of Rhinolaryngology, New York Polyclinic Medical School and Hospital.

1. Dugmore, Radclyffe: Personal communication to the authors.

2. Paget, James: Lectures on Surgical Pathology, ed. 3, Philadelphia, Lindsay & Blakiston, 1865, pp. 477 and 478.

3. Home, E.: Observations on Certain Horny Excrescences of the Human Body, Phil. Tr., London **81**:95, 1791.

on the Continent described the pathologic observations. By the middle of the nineteenth century attempts—usually unsuccessful—had been made to remove them.

The first of these attempts in this country was at the Massachusetts General Hospital in 1864. Although four chisels were used, it was found impossible to remove the growth. When the patient died five weeks later, postmortem examination of the specimen showed the tumor to measure 12.5 by 12 by 12.5 cm.

The first monograph on the subject which I have encountered is that Dolbeau [4] was inspired to write after seeing a case at the Hotel-Dieu, Paris, in 1864. He was able to remove the growth successfully, and this "happy result" naturally suggested an investigation as to the reason for the almost universal failure of the efforts of his predecessors. Though in the light of present knowledge Dolbeau's very complete effort is a literary curiosity, it seems to be little known in this country, as the copy published in 1871 and donated by Mrs. John Jacob Astor to the library of the New York Academy of Medicine in 1888 remained uncut until perused in the course of preparing this article.

In 1880 Knapp,[5] whose attainments illuminated both German and American ophthalmology, was able to make a second successful report. Although it was many years before these two triumphs were duplicated, Knapp continued to advocate surgical removal of osteomas of the frontal sinus, advising subperiosteal enucleation of moderate-sized growths, with warnings as to avoidance of injury to the dura mater. The spread of the doctrines of Pasteur and Lister, together with the increased employment of anesthesia, soon began to make nasal and intracranial surgical procedures far easier and less hazardous than had ever been dreamed of by the earlier workers in this field.

When Tauber [6] reviewed the literature in 1898, he found that osteoma of the frontal sinus had been attacked surgically in 20 cases, and though the death rate remained high—9 deaths, or 45 per cent—the prognosis was steadily improving. Hucklenbroich [7] chose this subject for his dissertation at Freiburg in 1905. Gerber's [8] monograph, published in 1907, listed 87 proved instances which he had collected from the literature or had seen. Sewall [9] in 1918 increased the list to 93. Harris [10] in 1928 was able to add 24 more, bringing the total to 117.

4. Dolbeau: Bull. Acad. de méd. **36**:564, 1871.
5. Knapp: Arch. f. Ophth. **6**:185, 1880; Tr. M. Soc. New York, 1881, p. 252.
6. Tauber: Zentralbl. f. Chir. **29**:775, 1898.
7. Hucklenbroich, P.: Inaug. Dissert., Freiburg, 1905.
8. Gerber: Arch. internat. de laryng. **23**:1, 1907.
9. Sewall, E. C.: Ann. Otol., Rhin. & Laryng. **27**:275, 1918.
10. Harris, Robin: Osteoma of Frontal Sinus: Report of 2 Cases, Laryngoscope **38**:331, 1928.

Roger's[11] thesis, inspired by the cases of Lemaitre and Aubin, was presented in 1932. It opens with a very full review of the literature and lists a total of 140 cases recorded up to that time.[12]

Ballenger[13] in his textbook quotes Garrettson (1927) as placing the number of known cases at about 215. Examination of Garrettson's paper[14] reveals this statement, but no authority is cited, and the list of references is meager, containing no recent items. It appears, therefore, that the greater rarity indicated by Roger's list with a complete bibliography is the more dependable.

A search of recent literature has added 6 more cases—those of Parsell,[15] Grillo,[16] Knapp,[17] Fenton,[18] Colson[19] and Patriarca.[20] Including that presented here, the number of cases of osteoma of the frontal sinus now totals 147.

This number is still small enough to make the lesion of sufficient rarity to command unusual interest.

ETIOLOGY

Though numerous theories have been advanced to account for the origin of these growths, their true etiology is still unknown. It is noticeable that they occur much oftener in males than in females. Only 2 of the 17 cases reports of which have appeared in recent literature occurred in women, and the impression left after going over the earlier collected cases is that the incidence among females is even less than this. The fact that the male frontal sinus is considerably larger than that of the female, affording more space for development, may have something to do with it. To those who hold that trauma is a deciding influence, the more exposed life of the male may tend to make him more liable to osteomatous formation. As half of the cases were in adolescents, and more than 80 per cent in persons under 45 years of

11. Roger, Jacques: Thesis de Paris, no. 7, 1932.

12. The references cited in footnotes 1 to 11 contain bibliographies, to which the reader is referred for lists of the reported cases.

13. Ballenger, W. L.: Diseases of the Nose, Throat and Ear, Philadelphia, Lea & Febiger, 1930.

14. Garrettson, W. T.: Osteoma of the Frontal, Maxillary and Sphenoid Sinuses, with Report of Cases, Arch. Otolaryng. **5**:135 (Feb.) 1927.

15. Parsell, L. A.: Osteoma of the Frontal Sinus, Arch. Otolaryng. **16**:863 (Dec.) 1932.

16. Grillo, M.: Osteoma del seno frontale, Gior. d. med. prat. **14**:427, 1932.

17. Knapp, E.: Ueber ein Stirnhöhlenosteom, Monatschr. f. Ohrenh. **67**:903, 1933.

18. Fenton, R. A.: Nasociliary Neuralgia Caused by Osteoma, Ann. Otol., Rhin. & Laryng. **42**:911, 1933.

19. Colson, Z. W.: Frontal Osteoma; Moulding Misplaced Frontal Septum; Case Report, Laryngoscope **43**:677, 1933.

20. Patriarca, A.: Riv. oto-neuro-oftal. **11**:153 (March-April) 1934.

age, it is evident that the formations arise during the period of greatest growth and physical activity. But as this is true of bony tumors in general it has no special bearing on those forming in the frontal sinus.

The theories which have from time to time been offered in regard to the etiology of osteoma of the frontal sinus are: (1) that the origin is embryologic, (2) that it is traumatic, and (3) that it is infectious.

Embryologic Theory.—In the new-born infant the frontal sinus is not developed. Even as late as the third year only traces of its formation can be made out, and it is not until the seventh year that it is definitely present. Even then it has much progress to make before it attains full growth and dimensions, as this state is not reached until adolescence. The frontal bone develops from membrane, while the adjoining ethmoid bone originates as cartilage. As these two structures are in process of ossification they come together. According to the widely accepted theory of Cohnheim, when, in the course of development, tissues of different nature come together, tumor growth is liable to take place. Therefore, cartilaginous "rests" may very well be left in the frontal sinus from which osteomas will develop when the period of active normal growth is slowing up or has wholly ceased—that is, in the situation we are considering, at adolescence or during the next two decades, precisely the time of life when osteoma of the frontal sinus is regularly found. Moreover, it has been stated by Sappey, whose authority as a histologist carries weight, that the periosteum in this region is exceptionally prone to ossification, which gives reason for assigning a periosteal origin to these tumors.

Traumatic Theory.—Much stress was laid by earlier writers on a history of antecedent trauma. The value of this is doubtful, if for no other reason than that few active boys from 15 to 25 years of age escape without some bumps on the forehead. If this were likely to produce osteoma of the frontal sinus, the male population of that age would be almost universally afflicted. That trauma superimposed on embryolic remnants predisposed to the formation of tumor induces such growths is a more tenable theory; but even this will not endure close examination as being applicable to all the cases recorded.

Infection Theory.—The frequency of nasal infection as well as the prevalence of syphilis and other constitutional involvements makes the theory that osteoma of the frontal sinus has an infectious origin seem logical in many of the reported cases. Syphilis, especially, was often incriminated by the earlier writers; but it is noticeable that those who have made studies in the past twenty years, since the Wassermann test came into general clinical use, have little or nothing to say concerning this. Hucklenbroich[7] found that in 37.5 per cent of the cases he collected there was an antecedent history of sinusitis.

Gerber [8] upheld the theory of infection, observing that the frontal sinus is peculiarly liable to inflammatory irritations which are capable of producing abnormal bony formations. "Though these irritations *may* be of exogenous origin (i. e., traumatic)," he said, "far more often they arise from internal causes, provoked by latent and torpid sinusitis. These irritations exercise their influence with maximum intensity during the period of bone formation, while the frontal sinuses are in full developmental activity. This is why we encounter these growths most often between the ages of ten and thirty years."

At the meeting of the Royal Society of Medicine in London on June 9, 1915, Wray [21] exhibited an autopsy specimen of "bony growth of the frontal sinus," which he said he "would not call a case of osteoma," but rather "a considerable thickening of bone" caused by the chronic inflammation from which the patient had long suffered. But he added that if a flap were simply turned down and an examination made through the opening, "one would infer that it was an osteoma." This might be regarded as strong confirmatory evidence of the inflammatory origin of osteoma of the frontal sinus in all instances.

PATHOLOGY

So far as their place in the catalogue of neoplasia is concerned, Gerber has well said of these growths that they are benign in that they are formed only from conjunctive tissue analogous to that from which the normal organism is constructed. "But," he continues, "they are *malignant* because, both by their capacity for enormous development, and their situation in direct proximity to vital organs, they menace the life of the host." The pressure exerted by a benign growth is just as fatal as that of a malignant growth if that pressure happens to be exercised on the brain.

The early anatomists who came on tumors of the frontal bone in animals called them "calcified brains," and later these were frequently known as "ivory tumors" on account of their white eburnated appearance. The center is more or less cancellous, and the outer capsule is hard and ivory-like. The pedicle which commonly joins the growth to the wall of the sinus is also cancellous. The exterior form is usually irregular, following the outlines of the wall of the sinus, and in those specimens which show haversian canals and lacunae these openings are also very irregular in shape, though a cross-section may show concentric or radiating striae. In some of the earlier case records we read that the tumors "came loose" and even fell out of the orbit after the eye had been destroyed.

21. Wray, C.: Proc. Roy. Soc. Med. (Sect. Ophth.) **8**:126, 1915.

Tillmanns [22] operated on a patient whose sight had been destroyed by such an unattached bony tumor pressing on the orbital contents. Bland-Sutton [23] related in detail the history of a sailor, told to him by Lediard, in whom the small bony growth noted at birth gradually grew larger, destroying the sight of the left eye and filling the orbit, until at age 35 it fell out of its own weight. This story also gives some conception of the length of time one of these tumors may take to attain full size.

Many of the later writers have reported mucoceles which often project through the dura into the substance of the brain. These are cystlike cavities in which the secretion excited by the presence of the foreign body in the sinus tends to collect. Such complications increase the difficulties of operation and the risk undertaken by the patient.

SYMPTOMS AND DIAGNOSIS

The frequent finding of bony growths in the sinuses of subjects coming to necropsy speaks for a more common occurrence of such lesions than the prevalence of symptoms indicates. Most of them, however, tend to increase steadily in size, apparently enlarging centrifugally, expanding the walls of the sinus and producing an ever-increasing inflammation and obstruction to drainage of the inflammatory secretions. Pressure atrophy rapidly takes place in the surrounding normal bone structure, the wall of the sinus often being completely obliterated by the time the patient comes for examination. The direction taken by the enlargement decides what the character of the symptoms will be. Most frequently this direction is toward the orbit, but in many instances it has been into the zygomatic, temporal or cranial fossae, or through the septum which divides the frontal sinus where the growth originated from its mate on the opposite side. Rarely, they extend downward into the nostrils.

No matter what direction the enlarging tumor may take, its presence is soon evidenced by symptoms of pressure, namely, displacement of the invaded organs and the chain of consequences which invariably follow sinusitis and nasal obstruction. The results of orbital invasion are best known. The eyeball is displaced, the growth first interfering with normal ocular motion so as to produce diplopia and later destroying the tissues altogether. In its abnormal exposed position the eye is almost certain to become infected secondarily, which increases the menace to vision. The classic indications of a tumor of the brain are very often present, that is, headache, mental dulness, sometimes nausea and vomiting, together with vertigo and the subtle but positive changes in dispo-

22. Tillmanns: Arch. f. klin. Chir. **32**:677, 1885.

23. Bland-Sutton, J.: Tumours Innocent and Malignant, ed. 7, New York, Paul B. Hoeber, Inc., 1922, p. 54.

sition which are the most tragic of the responses to pressure on the brain—irritability, melancholia and sometimes epileptiform seizures. Armitage [24] laid stress on the formation of large intracranial mucoceles. In his own case, such a mucocele ruptured into the lateral ventricle, with later formation of a pneumocele.

A diagnosis in the earlier cases was made only when the tumor attained sufficient size to be palpable or when its effects became visible, such as displacement of the eye. The advance in knowledge of cranial pathways and of the topography of the skull, together with the employment of the x-rays in their study, now enables one to make the diagnosis much sooner and thereby greatly increases the chances of successful surgical intervention. In patients who do not come under treatment until the effects of the orbital invasion are evident the condition can be diagnosed even without the aid of the x-rays.

PROGNOSIS AND TREATMENT

The outlook for those patients who come under treatment promptly is very good indeed. As these tumors are histologically benign, the dangers of recurrence are not great, and radical removal may be undertaken safely unless there is some systemic contraindication. Most of the patients are otherwise in good condition, except those who have been depleted by long neglected sinusitis. For these patients supportive measures are best employed before operation is undertaken, unless the tumor is enlarging with rapidity.

The subject of the following report was referred to us by Dr. N. B. Cohen, of Perth Amboy, N. J.

REPORT OF A CASE

History.—A salesman, 32 years old, was admitted on June 28, 1934, to the New York Polyclinic Hospital, complaining of displacement of the right eye with diplopia. He had first noticed drooping of the right eyelid following an attack of rhinitis about seven months previously. He consulted a physician at that time, but was told that it was "imagination." The lid continued to droop, and after three months frontal headache began. When this became severe, he was given some "sinus treatments," but was still told that there was nothing wrong with the right eye. But when, three weeks before hospitalization, he consulted a physician because of a small cyst in his left upper lid, the downward displacement of the right eye had become so marked that the existence of some abnormality could no longer be denied.

Examination.—A roentgen examination was made, which revealed the condition shown in figures 2 and 3.

The patient was rather thin, but the general physical examination gave essentially negative results. The past history was irrelevant except for a trauma to

24. Armitage, G.: Osteoma of Frontal Sinus, with Particular Reference to Its Intracranial Complications, and with Report of Case, Brit. J. Surg. **18**:565, 1931.

the forehead incurred in a fight when he was 17 years of age. The teeth were in poor condition, and chronic inflammation of the tonsils and nasopharyngeal mucosa was present. The hearing was normal, and no discharge from the ears or nose was present. There had been no headaches in the recent past; the patient said that he slept well and did not worry. No notations were made as to any change in his disposition since the displacement of the eye was first observed.

The left eye showed moderate chronic conjunctivitis but was otherwise normal. The lid of the right eye drooped. The eyeball was markedly displaced downward, the cause being a firm mass which extended from the region of the right frontal sinus above. This region was somewhat enlarged, and engorgement of the conjunctival vessels of the displaced eyeball was in evidence. Just above the right outer canthus, under the conjunctiva, was a small body which it was believed might well be a displaced accessory lacrimal gland.

The preoperative diagnosis was osteoma of the right frontal sinus, invading the right orbit.

Fig. 1.—The patient before operation.

Operation.—On June 29, 1934, the patient was operated on under ether-oil rectal anesthesia. A preliminary incision was made on the right side of the nose, extending from the lower border of the nasal bones upward, half way between the median line and the inner canthus of the right eye, through the middle of the eyebrow to the outer edge of the sinus. In its lower part the incision was carried entirely through the periosteum down to the bone, but above it descended only as far as the periosteum. The suborbital periosteum was exposed by careful dissection along the side of the nose, and a transverse incision was made through the periosteum over the supra-orbital ridge, so that the periosteum might be stripped upward. A parallel periosteal incision was made below the first one, permitting a similar dissection and separation over the roof of the orbit.

The anterior wall of the frontal sinus was opened with a chisel and completely removed down to the bridge by means of a Hajek bone-punch. This exposed a

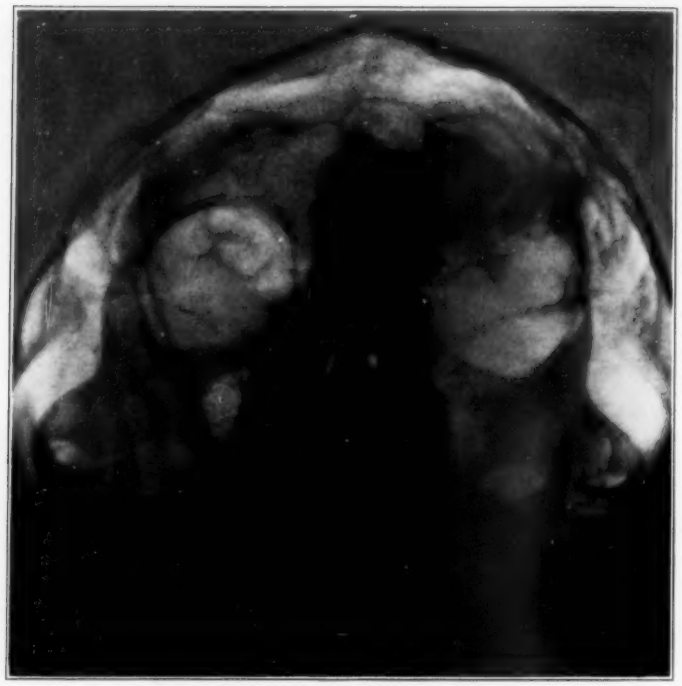


Fig. 2.—A roentgenogram showing the osteoma of the frontal sinus, antero-posterior view.

Fig. 3.—A roentgenogram showing the osteoma of the frontal sinus, lateral view.

hard, ivory-like mass which was of a duller hue than the surrounding walls of the sinus. It was attached by a broad base to the cranial plate as well as to the posterior surface of the bridge, and extended downward so as to involve the floor of the sinus—which is also the roof of the orbit—and outward as far as the external angular process. The mass not only occupied the entire right frontal sinus, which was fairly large, but extended into the left frontal sinus, as well as invading the orbit. The base of attachment measured almost 2 cm. in extent, and consider-

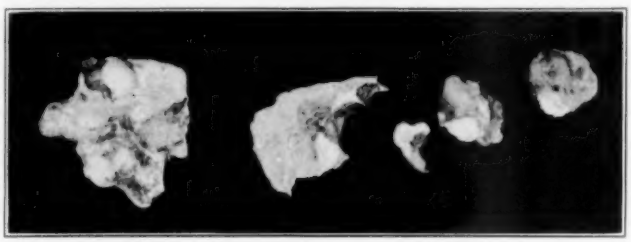


Fig. 4.—Specimens of the osteoma removed at operation.

Fig. 5.—The patient after operation.

able difficulty was experienced in cutting through it (which had to be done with a dental drill) as there was danger of injuring the cranial wall or the meninges. The main bulk, removed with the aid of chisel, mallet and rongeur, was about the size of a hen's egg.

The aspect of the tumor opposite the site of attachment was softer and somewhat spongy, with a tendency to bleed. Polypoid masses, resembling the mucoceles described by Armitage and others, were found in the sinus, filled with a thick,

gluey, gelatinous material which was also free in the cavity. The polyps were removed with forceps, and the secretion was suctioned out.

As the superior orbital plate—the floor of the sinus—was found to be invaded, it was deemed necessary to remove this also, as well as the portion near the external angular process. The middle of the anterior wall was further removed so as to extend the opening to the anterior wall of the left frontal sinus. On inspection of the interior of the left sinus, a detached shell of bone, like a half-shell of an oyster, filled with mucoid material, was found and removed.

Bleeding throughout the operation was fairly brisk but was readily controlled by clamps and ligatures. The wound was cleansed with a 2 per cent mercurochrome solution and packed with two strips of gauze, one strip extending externally as far as the outer border and the other toward the middle of the wound. The vertical incision was closed with interrupted catgut sutures, but the horizontal portion was left open and covered with a generous gauze dressing.

Microscopic Examination.—The specimen was studied by the pathologist, Dr. Aaron S. Price, and found to consist of a large amount of mucus and irregular bony exostosis, which was eburnated and measured about 2.5 by 3 cm. There were also six other irregular hard fragments of bony tissue and a flattened thin portion of bone from the face.

Microscopically, the bone showed sclerosis with marked edema of the overlying mucous membrane, which corresponded in structure to that of an exostosis. The opinion of the pathologist was that this was an exostosis or an osteoma.

Postoperative Course.—The recovery was uneventful. There were few complaints of pain or discomfort, and the wound healed without complications. The patient was discharged on the sixteenth postoperative day and has so far remained in excellent condition.

330 Park Avenue.

10 West Eighty-Second Street.

EFFECTS OF IRRADIATION ON ALLERGIC NASAL MUCOSA

FINAL REPORT

L. BENNO BERNHEIMER, M.D.
CHICAGO

Preliminary observations of the effects of irradiation on allergic nasal mucosa have been reported.[1] It was stated in the last communication that (*a*) irradiation of forty patients suffering from verified vasomotor rhinitis gave excellent clinical results, these results remaining constant for one year, that (*b*) the method of irradiation described had proved safe during this period, and that (*c*) an analysis of the effects of irradiation in a series of patients with hay fever was under investigation. This work was presented before the Chicago Laryngological and Otological Society[2] and brought forth strong criticism as to both the permanency and the safety of the method of treatment of hyperesthetic rhinitis described. The possibility of latent atrophy resulting from irradiation was especially stressed.

The purpose of this communication is (*a*) to evaluate the permanency and safety of this method of treatment of allergic rhinitis, sufficient time (three years) now having elapsed, and (*b*) to report the clinical results obtained by irradiation of twelve patients suffering from seasonal hay fever.

A review of the histopathologic structure[3] of the nasal mucosa of patients with hyperesthetic rhinitis and seasonal allergic rhinitis recalls a picture of pronounced hyperplasia of the surface epithelium, absence of cilia, isolated areas of desquamation and edema of the subepithelial tissue, which is characteristically transitory. There is an infiltration of lymphocytes, plasma cells and eosinophils. As the disease

---

This paper was submitted as a thesis in partial fulfilment of the requirements for membership in the American Laryngological, Rhinological and Otological Society.

1. Bernheimer, L. B., and Cutler, Max: Effects of Radiation on Allergic Nasal Mucosa, Arch. Otolaryng. **16**:561 (Oct.) 1932; Effects of Radiation on Allergic Nasal Mucosa, ibid. **17**:658 (May) 1933.

2. Bernheimer, L. B., and Cutler, Max: Effects of Radiation on Allergic Nasal Mucosa, Arch. Otolaryng. **17**:727 (May) 1933.

3. Hansel, F. K.: Allergy and Its Relation to the Inflammatory Diseases of the Paranasal Sinuses, Ann. Otol., Rhin. & Laryng. **39**:510 (June) 1930. Deane, L. W.: Recent Advances in Otolaryngology, Ann. Otol., Rhin. & Laryng. **38**:952, 1929. Hirsch: Origin of Nasal Polypi, Zentralbl. f. Hals-, Nasen- u. Ohrenh. **9**:745, 1927.

progresses atrophic changes take place, which with late secondary infection may obscure the allergic process.

It is also well to recall the effects of irradiation on the normal nasal mucosa. The initial effect is erythema, which is caused by local circulatory disturbances occurring several days after exposure. The changes induced in the blood vessels by irradiation consist of erythema and edema,[4] the lesion first being observed in the endothelium. Sometimes endothelial cells desquamate into the lumen, causing occlusion, and sometimes they obliterate the canal by proliferation.[5]

An application of filtered radiation to the mucous membrane results in a selective cytolytic effect on the germinal layer of the stratified epithelium. This effect occurs during the first days after exposure.[6] When the dose of radiation is sufficiently strong, true *radio-épithélite* results, owing to destruction of the germinal layer of epithelium. The destruction and falling off of the surface epithelium occur about the twelfth day after irradiation. Coutard showed that under the same technical conditions of irradiation the falling away of the cutaneous epidermis occurs later, i. e., on from the fifteenth to the twentieth day. Reparation of the lesion takes place between twenty-two and twenty-seven days after irradiation of the mucous membranes and about forty-two days after irradiation of the cutaneous epidermis.

The effect of irradiation on sweat and sebaceous glands is diminution and suppression of their secretions. The mucous glands of the nasal mucous membrane are affected in a similar manner. When the irradiation is intense these glands atrophy and disappear.[7] The connective tissue is the most radioresistant, and with exposures to radiation it undergoes a slow process of fibrosis.

The method of irradiation the effects of which have been described [1] is as follows: After cocainization of the nasal mucosa 50 mg. of radium was introduced into each nasal chamber and allowed to remain in place for two hours (total dose, 200 mg. hours). The radium element was

4. Gassmann, A.: Zur Histologie der Röntgenulcera, Fortschr. a. d. Geb. d. Röntgenstrahlen **2**:199, 1899. Halkin, H.: Ueber den Einfluss der Becqerelstrahlen auf die Haut, Arch. f. Dermat. u. Syph. **65**:201, 1903. Danysz, J.: De l'action du radium sur les différents tissus, Compt. rend. Acad. d. sc. **137**:1296, 1903. Thies: Wirkung der Radiumstrahlen auf verschiedene Gewebe und Organe, Mitt. a. d. Grenzgeb. d. Med. u. Chir. **14**:694, 1905.

5. Dobrovolskaia-Zavadskaia, N.: Modifications des fibres striées sous l'influence d'irradiations prolongées au moyen de foyers radifères introduits dans les muscles, J. de radiol. et d'électrol. **8**:69, 1924.

6. Regaud, C., and Nogier, T.: Les effects produits sur la peau par les hautes doses de rayons X selectionnés par filtration à travers 3 et 4 millimetres d'aluminium: Applications à la roentgenthérapie, Arch. d'électric méd. **21**:49, 1913.
à l'emploi des rayons X, France méd. **45**:113, 1898.

held in four brass capsules, each capsule containing 25 mg. of radium in silver containers. The total thickness of filtration was 0.5 mm. of silver and 1 mm. of brass. One capsule was placed in each middle meatus and one in each inferior meatus. Usually both sides of the nose were irradiated simultaneously.

The forty persons with hyperesthetic rhinitis have now been under observation for three years. They originally gave a typical history of spasmodic attacks of sneezing, followed by profuse watery discharge and nasal block, the symptoms occurring without relationship to season or climate. Nasal examination in all cases revealed the usual pale, water-logged mucosa found in cases of allergic nasal disease. Eleven of these persons had demonstrated sensitization to one or more foods or inhalants, showing positive cutaneous reactions to such atopens as orris-root, house dust, kapok, chicken feathers, wheat, egg albumin and beef. However, none had responded to allergic therapy. Twenty-nine of the forty persons irradiated had previously submitted to some form of intranasal surgical procedure, such as submucous resection, intranasal or sublabial antrotomy, exenteration of the ethmoid or sphenoid sinuses or repeated nasal cautery. The relief obtained from these procedures had been transitory. No patient was irradiated if polyps or secondary nasal infection was present, radium being introduced into the nose only after these secondary changes had responded favorably to indicated therapeutic measures.

In the preliminary report it was stated that the initial effect of irradiation on the allergic nasal mucosa was erythema, the congested, red nasal membranes causing nasal block. The erythema and block persisted for from three to eight weeks, slowly resolving until the mucosa became normally pink and ample breathing space was established. During this period of erythema and congestion there was a copious mucopurulent discharge, which slowly lessened and finally subsided with the disappearance of the erythema. The sneezing usually stopped immediately after irradiation, so that by the end of the eighth week the irradiated patient was free from symptoms, the nasal mucous membrane at this time being normally pink. However, in some cases the paleness persisted in spite of the disappearance of the edema (table 1).

Microscopic examination of a fragment of allergic nasal mucosa excised eight weeks after irradiation showed pronounced morphologic changes. The subepithelial intercellular edema and dilated tissue spaces which constitute the characteristic microscopic picture in the untreated diseased membrane were entirely absent. There was also absence of signs of acute inflammation. Dilatation of the capillaries and leukocytic infiltration had disappeared. The mucous glands were no longer separated by edematous intercellular tissue but were crowded together.

Isolated foci of lymphocytes and plasma cells had replaced the previously widespread acute cellular infiltration. The microscopic appearance of the tissue closely approached that of normal mucous membrane.

Three years have now elapsed since these forty patients were irradiated; so it is believed that a statement can now be made concerning the permanency of the effects. For the sake of clarification the following table is submitted, showing the end-results of irradiation of patients with hyperesthetic rhinitis after the period of three years (table 2).

TABLE 1.—*Observations After One Year of Clinical Results Obtained by Irradiation in Forty Cases of Hyperesthetic Rhinitis; Microscopic Appearance of Nasal Mucosa*

No. Cases	Percentage	Sneezing	Nasal Block	Watery Discharge
21	52	Complete relief	Complete relief	Complete relief
8	20	Lessened	Complete relief	Complete relief
3	8	Lessened	Lessened	Complete relief
4	10	Lessened	Lessened	Lessened
4	10	No relief	No relief	No relief

Nasal Mucosa	No. Cases
Normal pink color with no water-logging or block	19
Paleness but no water-logging or block	13
Paleness with mild block and water-logging	4
Paleness, water-logging and nasal block	4

Microscopic Section of Nasal Mucosa	
Nearly normal	11
Unchanged	1

TABLE 2.—*Observations After Three Years of Clinical Results Obtained by Irradiation in Forty Cases of Hyperesthetic Rhinitis*

No. Cases	Percentage	Sneezing	Nasal Block	Watery Discharge
19	47	Complete relief	Complete relief	Complete relief
9	22	Lessened	Complete relief	Complete relief
3	8	Lessened	Lessened	Complete relief
5	13	Lessened	Lessened	Lessened
4	10	No relief	No relief	No relief

Nasal Mucosa	No. Cases
Normal pink color with no water-logging or block	17
Paleness but no water-logging or block	14
Paleness with mild block and water-logging	5
Paleness, water-logging and nasal block	4

With reference to the possibility of nasal atrophy resulting from the use of radium in the amounts described, the accompanying photomicrographs taken in six unselected cases of the nineteen in which complete relief was obtained are submitted. It will be noted that no macroscopic or microscopic atrophy is evident. The tissue shows vacuolation of the lining epithelium and interepithelial infiltration of inflammatory cells. There is edema in the submucosa with a considerable number of fibroblastic cells.

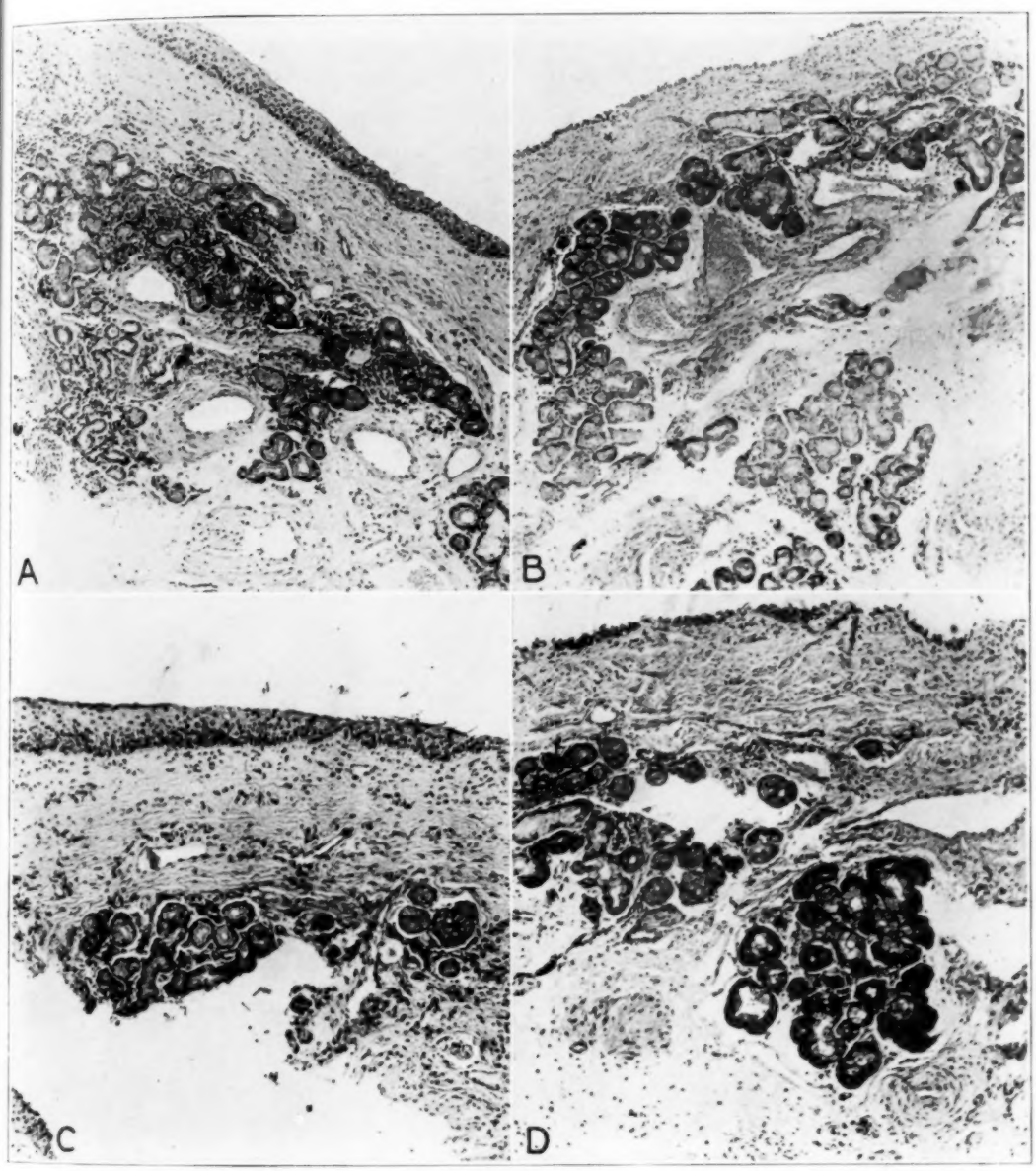


Fig. 1.—Sections from the nasal mucosa of four patients with hyperesthetic rhinitis who had obtained complete relief, taken from two and a half to three years after irradiation.

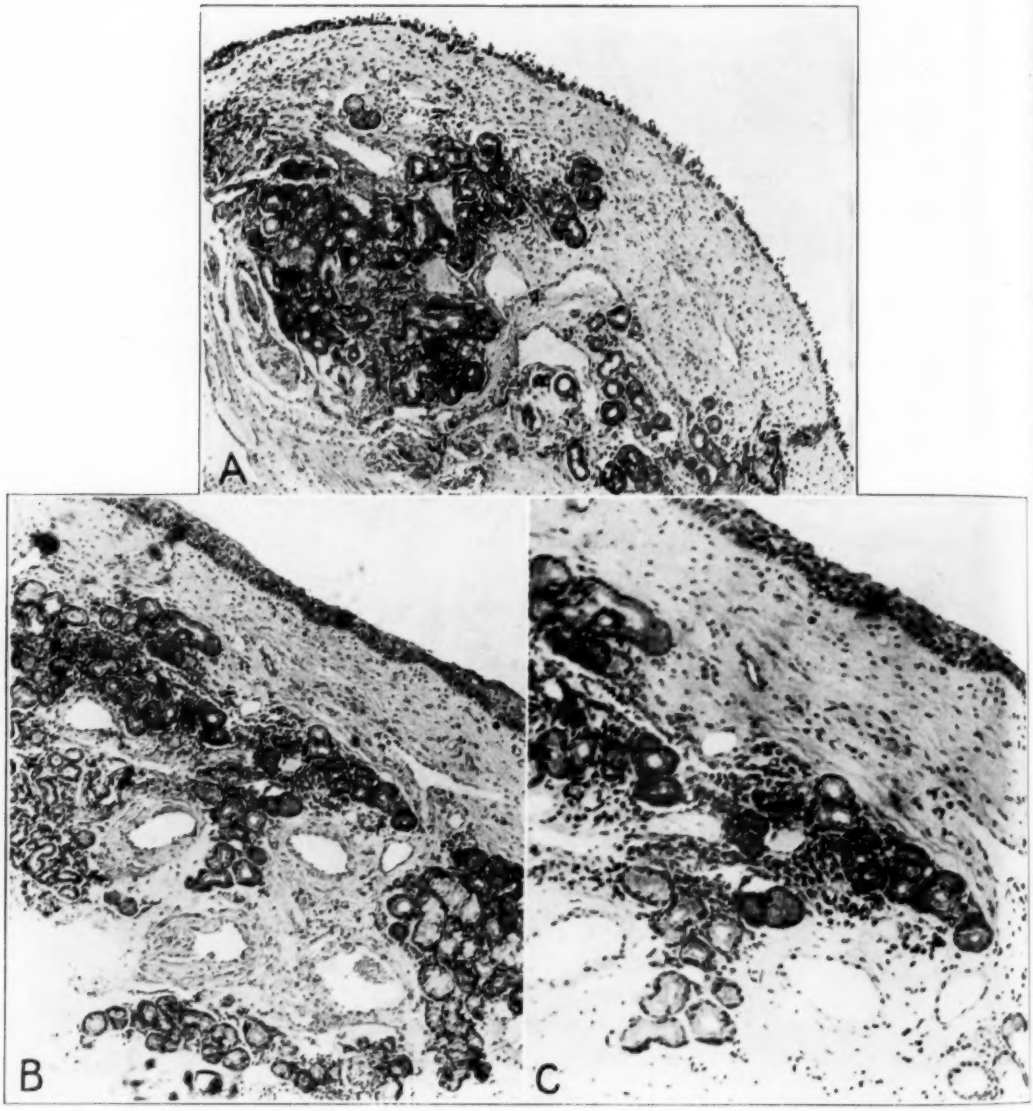


Fig. 2.—Sections from the nasal mucosa of two patients, taken from two and a half to three years after irradiation. *C* is the field seen in *B* photographed with a high power lens.

In one photomicrograph taken with the high power lens it will be noted that the mucous glands show no abnormality. There are marked infiltration of lymphocytes between the tubules and a new formation of connective tissue. The secretion of the epithelial cells and absence of atrophic changes are noticeable.

SUMMARY

Forty patients with hyperesthetic rhinitis were irradiated, and the end-results were recorded after a period of three years, the clinical results being shown in table 2. Forty-seven per cent of the patients were free from symptoms after three years; 22 per cent no longer had nasal block or watery discharge, so that, while sneezing persisted to a moderate degree, from the standpoint of the patient's comfort the clinical result was excellent; 8 per cent were moderately comfortable and the breathing space was unimpaired, although sneezing and discharge persisted; 13 per cent received but little relief, and 10 per cent were not benefited.

CONCLUSIONS

1. Irradiation of forty patients suffering from vasomotor rhinitis has given satisfactory clinical results in a large percentage of the patients treated after a period of three years.

2. The method of irradiation described has proved safe, no evidence of macroscopic or microscopic atrophy being evident after three years.

3. Treatment of hyperesthetic rhinitis with radiation is advanced not as a method which should supplant other therapeutic measures but as a valuable adjunct to the symptomatic treatment of this annoying condition.

4. The results of radiation therapy on twelve patients with verified cases of seasonal allergic rhinitis were uniformly negative.

NUCLEIC ACID AND NUCLEOTIDE THERAPY IN NASAL DISEASES

CONTRIBUTIONS TO THE STUDY OF THE CHEMICAL ASPECTS OF NASAL DISEASES

SIMON L. RUSKIN, M.D.
Attending Otorhinolaryngologist, Bronx Hospital
NEW YORK

Modern chemistry holds many essential building stones for the understanding of the metabolism of mucous membrane, what it produces and what chemical substances are formed in retained secretions, what influences changes of p_H have on secreting membranes and, further, what systemic chemical changes manifestly affect the mucous membrane.

Before one proceeds with the chemical study it is important to view the nose and the accessory nasal sinuses anatomically for the biophysical aspects. The cavities of the sinuses are covered by an almost single cell epithelial layer supported by a loose reticular structure and forming an almost dialyzing membrane. There are barely any glands, and such as are present lie close to the orifice of the sinuses. Here is a mechanism for rapid transudation of large volumes of fluid and similarly an area for movement in the opposite direction or absorption. This is independent of the question of pathogenic organisms per se and can be viewed from the light of those physical factors which determine the movement of fluids as influenced by electrolytes, lipoids and p_H. Here one observes, first, a movement of fluid and formed elements of the blood in the inflammatory response to infection passing from the circulation through the membrane into the sinus cavity, followed by a period in which equilibrium is restored and then a movement in the opposite direction whereby fluid and the disintegrated products of elements of the blood, such as cholesterol, unsaturated and saturated fatty acids and products of protein decomposition in the various stages, will be absorbed. The rate of absorption of these substances is determined by changes of p_H of the contents. The entire mechanism is thus one that may be completely reversible; yet, on the other hand, a continuation of the local pathologic condition with a persisting stimulus to transudation may produce a balanced system proceeding in both directions continuously, so that the blood stream loses fluid, formed elements and electrolytes while it takes on part of the fluid, electrolytes of altered charge, cholesterol, saturated and unsaturated fatty acids and glutathione, the products of cellular disintegration.

This continuous chemical exchange influences the oxidation-reduction mechanism of the blood. The continuous absorption of unsaturated fatty acids would in itself be sufficient to affect the oxidation mechanism through its reaction with the bivalent ferrous ion so as to interfere with the formation of oxyhemoglobin. This may influence the characteristically low hemoglobin content of the blood in cases of nasal disease.

The remarkable buffer mechanism of the blood maintains itself within a narrow range of p_H through its proteins, calcium and phosphorus in a range different from the p_H of the secretions accumulated in the sinus cavity. This creates an essential difference in p_H on both sides of the sinus membrane. Thus, according to Mittermaier's chart, the average p_H for the contents of a chronically catarrhal antrum was between 7.9 and 8.76, whereas that of the contents of a chronically suppurative antrum ranged between 6.3 and 7.6. Chronic catarrhal secretions are to a large extent bacteriologically negative, and the p_H ranges well above and below that found in the blood stream, so that a disturbance in equilibrium between the two sides of the sinus membrane lasting a considerable time may produce serious biochemical deficiencies. One could practically consider the physical relationship between the body fluids and the contents of the sinus as separated by a semipermeable membrane and as creating a state of Donnan equilibrium.

A closer examination of the anatomic structure of the nose from its biophysical aspect reveals that the lateral nasal wall, the turbinates and the nasal septum histologically show an entirely different mechanism. The mucosa is firmly united to a submucosa which is extremely rich in blood vessels. The inferior turbinate, with large distensible venous sinuses, surrounds rich groups of mucous and serous glands, chiefly the latter, while the middle turbinate has a direct supply of blood vessels and a distribution of glands, chiefly mucus-producing. Around the sinus orifice and on the septum are profusely scattered mucous and serous glands. Here is a mechanism devoted largely to protection of the respiratory tract. This protection consists of a secretion composed of mucoprotein. The mucin is a relatively inert substance which acts as a mechanical envelop for foreign bodies and provides a defensive layer against entrance to the mucosa. The studies of the chemical structure of the mucoproteins by Levene have brought them into a place of great significance. He has pointed out the close chemical relationship of the mucoproteins to the hexosamines, which resemble the cellulose of plants but which in animals form an important constituent of the skin, skeleton, connective tissues and serous and mucous membranes, in fact, all those tissues which perform either an architectonic or a protective function. The function of these nitrogenous sugars is different from that of the simple sugars, and they do not possess

the same tendency to burn in the organism as do ordinary sugars. Their loss through any channel must be accorded the same attention that is associated with the loss of non-nitrogenous sugars.

Thus it can be seen that the anatomic physical structure determines two different types of secretion; on one hand, in the lining of the sinus there is a mechanism for transudation rich in nucleoprotein while, on the other hand, in the nasal lining there is a true secretory structure producing a discharge rich in mucoproteins. Although the two mechanisms usually occur together, one or the other is predominant. The loss of nucleoproteins from a continuously discharging sinus mucosa or from so-called catarrhal rhinitis or mucous membrane of the gastrointestinal tract will produce biochemical changes leading to what I would call hyponucleinemia, resulting in a disturbance which in the extreme form is characterized by changes of the blood which I have described as being found in the picture of nephrosis; whereas a severe loss of secretion affecting the nasal and pharyngeal mucosa must be viewed as associated with the loss of mucoprotein and those substances used by the liver and kidney in detoxicating mechanisms and associated with the picture of acute toxic nephritis. That combinations of both pictures occur is common experience. Nephrosis is, as a rule, bound up with chronic sinusitis, whereas acute nephritis is associated with nasopharyngitis, tonsillitis and exanthems. The occurrence of either nephrosis or nephritis following scarlet fever and influenza is clinically explained by the fact that although both of these diseases may cause profound involvement of the nasal mucosa with formation of large sloughs and protracted convalescence, they are equally able to cause the worst forms of sinusitis.

In a previous work I have pointed out that differentiation of nephrosis and nephritis in association with disease of the nasal and accessory sinuses can thus be made on the basis of difference in chemical disturbance. Additional evidence is thus presented to indicate that nephrosis may be considered as a biochemical disease in much the same light as diabetes. It may be considered a metabolic disease with a breakdown of the nucleoprotein balance in which the kidney suffers like other tissues. Anatomically, in the infant the nasal structures represent a much larger area of mucosa than the accessory nasal sinuses, while in older children the reverse is true, and the ratio increases still more as adult life is approached.

Coincidentally, the younger the child the greater will be the tendency toward the loss of mucoprotein and the biochemical disturbances associated with it. Thus, transient acute nephritis with rapid resolution is frequently noted. Older children having a nasal discharge from early

infancy with associated sinusitis give the most pronounced evidence of loss of nucleoprotein because of the increase in the size of the sinuses and the fact that the diet is as a rule not adapted to an adequate replacement of nucleoprotein. The adult diet, however, gives a much better opportunity for replacement of nucleoprotein.

It is my purpose not to present a conception of nephrosis but rather to pick out those manifestations associated with disease of the nose or mucous membrane and to secure for them a proper evaluation. In an excellent review of "Hypoproteinemia, a Condition Common to Many Disorders" Eli Moschcowitz pointed out the significance of loss of protein in the causation of nephrosis but made no mention of nasal diseases. When one stops to consider that in rhinitis and sinusitis there is often continuous discharge made up of nuceloproteins and mucoproteins, that the discharge is present through the day and night for weeks and months or often years, associated subsequently with bronchitis and bronchiectasis, one receives a much more impressive conception of nasal disease.

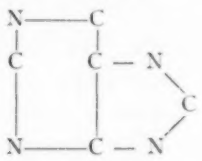
What metabolic adjustments have to be made to meet this constant demand has also received scant attention. That the thymus gland plays an important rôle in this function would appear most probable. The content of nucleic acid of the thymus is still the richest source of this substance in the animal body. It is also apparent that compensatory mechanisms against the loss of nucleotides set in; thus, early hyperplasia of lymphoid tissue and cervical adenitis are evident. Hypertrophied tonsils and adenoids also develop. These patients do not do well following removal of the tonsils and adenoids; puffiness of the lower lids frequently sets in following the procedure, and the parents date the beginning of serious trouble usually to the posttonsillectomy period. In more severe cases systemic compensatory mechanisms arise. There are a general lowering of metabolism and diminished thyroid activity with an increase in weight and what has been called a pseudorobust appearance. It is therefore incumbent on the physician to investigate the status of drain of nucleic acid before deciding on a tonsillectomy that will further deplete the mechanism for replacement of nucleic acid. Patients with chronic nasal discharge should be treated to eliminate the discharge prior to tonsillectomy in some cases. The removal of lymphoid tissue at a time when there is an increased demand for nuclear substances is met by a lowering of metabolism and the associated oxidation of body substances.

It is well at this point to branch off into a simple analysis of the chemistry of nucleic acid so that one may be able subsequently to analyze critically the chemical significance of its loss.

Nucleic acid when conjugated with albumin or globulin forms a nucleoprotein. As a rule the protein elements may change with the different tissues where the nucleoprotein is formed, but the nucleic acid radicals are relatively constant.

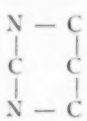
Nucleic acid is composed of four nucleotides, two of which are purines, having as the nitrogen-containing base adenine and guanine, respectively. The other two nucelotides are pyrimidins, having the nitrogen-containing bases thymine and cytosine. In plants, instead of thymine there is uracil. All four nucelotides have a common structure; thus the base is united with a glucoside which in nucleic acid of animals is a pentose, d-ribodesose, as well as with phosphoric acid.

The first two nucleotides are purines. To this type of structure belong the well known stimulants and diuretics caffeine, theobromine and theophylline. Adenine, which has been shown to play a rôle in the stimulation of the reticulo-endothelial system, has also been considered a circulatory hormone. The chemical structure is basically.



As to guanine, there is as yet little enlightenment from the physiologic standpoint.

The other two nucleotides, thymine and cytosine, are different from the purines; they are the pyrimidins and have the structure



To this group of structures belong barbituric acid and the depressants. Thus, barbital would be included.

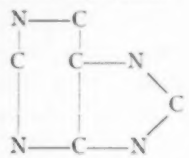
The changes of different groups on the no. 5 carbon atom gives phenobarbital and amytal. The further breakdown of the pyrimidin yields hydantoin, from which is derived the profound depressant phenyl-ethyl hydantoin. The final oxidation of the pyrimidins goes off into urea, carbon dioxide and pyruvic acid.

Thus, nucleic acid is a balanced mechanism of stimulants and depressants. It is also obvious that the purine nucleotides are substances of hormone character affecting circulation and water metabolism, whereas the pyrimidins are depressants, the accumulation of which would induce a state of stupor or coma.

An analysis of the physiology of the nucleotides can be graphically represented as follows:

NUCLEIC ACID

Adenine nucleotide
Guanine nucleotide



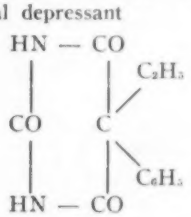
Purine structure resembling caffeine.

1. Stimulates reticulo-endothelial system; induces leukocytosis
2. Increases coronary circulation
3. Participates in carbohydrate metabolism
4. Participates in muscle metabolism
5. Acts as coenzyme
6. Is a glandular stimulant

etc.; stimulative.

Cytidine nucleotide
Uridine nucleotide

Pyrimidin structure resembling barbital depressant



1. Precipitates toxins and binds toxalbumin
2. Induces leukopenia on injection
3. Inhibits bacterial growth
4. In stronger dilutions is antiseptic
5. Acts like barbiturates on metabolism

The rôle of nucleic acid in the binding of toxin has been extensively demonstrated by Tichomiroff. Whether the toxin is bacterial, such as that of diphtheria, typhoid or scarlet fever, organic, such as benzene

and its derivatives, or metallic, such as arsenic or mercury, the end-result of the invasion of these substances is the call on the organisms for binding of the toxin as one of the defense mechanisms. That nucleic acid is one of these mechanisms is readily demonstrable with ricin and various plant and bacterial toxins. Whether this is accomplished through the death of the leukocyte and the liberation of the nucleic acid at the site of the invasion or by the formation of nuceloprotein by the mucous membranes is speculative, but the fact that the bacterial invasion of organisms producing a definite toxin is associated with manifestation of reaction on the part of the mucous membrane, lymphoid tissue, bone marrow and spleen indicates that such a relationship exists. That these invasions are of toxic origin is manifest in the usefulness of antitoxin. Experimentally the mixture of a lethal dose of diphtheria toxin with 1 cc. of a 3 per cent solution of manganese nucleotide injected together protected rabbits in one series of tests under careful control.

Nucleic acid does not occur free in the blood stream except in very small amounts but is available through the leukocytes or secretions of the mucous membrane, both of which are known barriers to invasion by toxins. The adenylic nucleotides, however, occur normally in the blood stream, as shown by Jackson and his associates.

As a demonstration of the rôle of nucleic acid in cases of nasal disease I chose to follow the course in several cases of nasal allergy because of the excessive loss of secretion. Of a series of thirteen cases five are described in detail.

REPORT OF CASES

Case 1.—Miss A. R., aged 32, a waitress, had vasomotor rhinitis for five years. She had had a variety of nasal treatments without benefit. Cutaneous tests showed no specific reaction. Three years before writing this report I made injections into one sphenopalatine ganglion, which gave relief for two years. She returned for more injections. Instead, I prescribed 10 grains (0.65 Gm.) of nucleic acid (yeast) three times a day. After the first week the patient noted marked relief in the vasomotor symptoms, sufficient to keep her comfortable and obviating any further treatment. The treatment was continued for three weeks with complete relief. At present she resorts to nucleic acid therapy with any return of symptoms without consulting me.

Case 2.—Bennett M., aged 9½, since infancy had nasal obstruction and discharge with slight periods of remission. He was found to be specifically sensitive to house dirt. Nasal examination revealed a typical example of allergic mucosa; the turbinates were bluish and boggy and obstructed the entire nasal space. There was at all times a thin mucoid discharge which necessitated frequent use of the handkerchief. The usual nasal treatments directed toward the nasal sinuses were of only slight benefit. The patient appeared pasty, his complexion was sallow, and the lower lids were puffy. Ten grains of nucleic acid three times a day was prescribed. After the first week a marked change appeared. The secretion diminished, nasal aeration improved, and the child appeared brighter and alert. After the second week the change was so marked as to call forth the astonished com-

ments of the parents. He continued to take nucleic acid for three months, after which all medication was stopped. Since then he has had only occasional mild recurrences, which have been controlled by medication with nucleic acid. After the diminished discharge set in a series of eight injections of ferrous adenylate was administered. This was accompanied by a rise in the hemoglobin content and a marked improvement in the complexion of the child. Nasal examination revealed normal-appearing mucosa with practically no evidence of nasal allergy.

Case 3.—Bobby R., aged 8, for two years prior to September 1933 had a history of almost continuous nasal disturbance with recurrent sinusitis, otitis and mastoiditis. He had eczema in childhood and asthma when he caught cold. During the two years prior to September 1933 he also had recurrent fever. The nasal discharge was reduced following the administration of bacteriophage, but there still was an amount of nasal discharge above normal. Nucleic acid therapy was begun in November 1934, and the amount of nasal discharge rapidly diminished, with a marked increase in the comfort and well-being of the patient. The puffiness of the lower lids disappeared. The nasal mucosa became normal, and the patient began to enjoy the first real relief from nasal symptoms.

Case 4.—Georgie C., aged 7, had had infection of the upper respiratory tract for several years; his appearance was pasty, and the lower lids were puffy. Nasal examination revealed typical allergic mucosa. There was a continuous nasal discharge, and swollen boggy turbinates occluded the nasal passages. Following the administration of bacteriophage there was definite improvement in the acute exacerbations of so-called repeated colds. The addition of nucleic acid was followed by a rapid change in the appearance of the mucosa. The bogginess of the turbinates disappeared, and improved aeration of the nasal passageway followed. The child's appetite improved and his restlessness disappeared. He has been free from symptoms for almost a year with only an occasional slight recurrence which has been controlled by nucleic acid therapy.

Case 5.—"Cookie" H., aged 11, since 1927 had had repeated infections of the upper respiratory tract which were resistant to treatment for several years. With the introduction of bacteriophage therapy the attacks of infection of the upper respiratory tract were readily controlled. Two years prior to this report marked dry eczematous patches appeared which, after the first year, persisted continuously under both armpits, on the lower lip and in patches on the face. The skin was markedly thickened and repeatedly cracked. Although there were remissions under various forms of treatment, at no time did it entirely disappear. Nasal examination revealed moderate obstruction of the nasal fossae. The mucosa was bluish and was covered by a thin secretion. Ten grains of nucleic acid three times a day was prescribed. After the first week the eczematous lesions began to disappear with such rapidity that by the end of the third week the patches were less than half their former size. The nucleic acid therapy was supplemented by six injections of ferrous adenylate. The total disappearance of the eczematous areas with restoration of a normal appearance of the nasal mucosa followed. In all, 120 doses of 10 grains each of nucleic acid were administered. For the past six months she has had no recurrences.

The marked benefit from the ingestion of nucleic acid in these cases tends to indicate that allergy is related to a depletion of nucleic acid possibly secondary to a chronic infection that has caused a continuous drain of nasal secretion. Wedgewood has shown that in cases of vitamin B deficiency there is an increased tendency to anaphylaxis and

sensitization to protein. The edematous tissues in cases of vitamin B deficiency have been shown by Wells to be very low in nucleic acid content.

The administration of nucleic acid has proved of benefit in cases of nasal polyposis associated with chronic sinusitis.

At present I employ nucleic acid as an adjunct to the treatment in all cases of chronic suppuration of the sinus on the basis of replacement therapy.

CONCLUSIONS AND SUMMARY

1. The anatomic structure of the nose permits severe loss of nucleoprotein through chronic discharges, either suppurative or allergic.

2. This loss manifests itself as a deficiency in some cases which appears as a disturbance of water metabolism allied to nephrosis.

3. Nasal allergy is related to nucleic acid metabolism and is benefited by replacement of nucleic acid.

4. Nucleic acid influences the water exchange of mucous membrane and may represent a cause of allergic manifestations.

5. Drainage of nucleic acid should be stopped before tonsillectomy is decided on.

351 West Eighty-Sixth Street.

BIBLIOGRAPHY

Bass, Lawrence W., and Baudisch, Oskar: New Methods of Splitting Pyrimidines: III. The Action of Iodine Solution on Pyrimidines, J. Am. Chem. Soc. **46**:181 (Jan.) 1924.

Baudisch, Oskar, and Davidson, David: The Oxidation of Isobarbituric Acid: A New Class of Indigoids, J. Biol. Chem. **64**:619 (July) 1925.

——and Davidson, David: The Catalytic Oxidation of Hydantoins, J. Biol. Chem. **75**:247 (Oct.) 1927.

——and Pfalz, Mimosa: The Decomposition of Pyrimidines by Means of Ferrous Salts, J. Am. Chem. Soc. **45**:2972, 1923.

Burge, W. E.: J. Pharmacol. & Exper. Therap. **12**:243, 1918.

Dahmlos, J., and Sole, A.: Biochem. Ztschr. **227**:401, 1930.

Degkwitz, R.: Klin. Wchnschr. **9**:2556, 1930.

Deuel, H. J., and Weiss, R.: Proc. Soc. Exper. Biol. & Med. **21**:456, 1924.

Doan, C. A.: The Neutropenic Salts, J. A. M. A. **99**:194 (July 16) 1932.

Doyon, M.: Compt. rend. Acad. d. sc., Paris **172**:1212, 1921.

Freudenberg, E., and Gyorgy, P.: Jahrb. f. Kinderh. **96**:5, 1921.

Gardner, J. A., and Gainsborough, H.: Biochem. J. **21**:141, 1927.

Hill, A. V.: Proc. Roy. Soc., London, s.B **106**:477, 1930.

Hober, P.: Am. Rev. Biochem. **1**:1, 1932.

Jackson, H., Jr., et al.: Am. J. M. Sc. **184**:297 (Sept.) 1932.

Jackson, H.; Parker, F.; Rhinehard, J. F., and Taylor, F. H. L.: Diseases of the Lymphoid and Myeloid Tissues, J. A. M. A. **97**:1436 (Nov. 14) 1931.

Jochius, J.: Klin. Wchnschr. **9**:2115, 1930.

Jones, W.: Nucleic Acids, New York, Longmans, Green & Company, 1920.

Kugelmass, I., and Shohl, A. T.: J. Biol. Chem. **58**:649, 1923.
Laskowinski, S.: Compt. rend. Soc. de biol. **91**:632, 1924.
Levene, P. A.: Hexosamines and Mucoproteins, New York, Longmans, Green & Company, 1925.
——and Bass, L. W.: Nucleic Acids, American Chemical Society, Monogr. 56, New York, American Chemical Catalogue Co., 1931.
McQuarrie, I.: Epilepsy in Children, Am. J. Dis. Child. **38**:451 (Sept.) 1929.
Marriott, W. K.: Northwest Med. **24**:472 (Oct.) 1925.
——ibid. **24**:472 (Oct.) 1925.
Mettier, S. R., and Olsan, H. T.: Ann. Int. Med. **6**:855 (Jan.) 1933.
Mittermaier, Richard: Arch. f. Ohren-, Nasen- u. Kehlkopfh. **127**:1, 1930.
Moschcowitz, Eli: Hypoproteinemia: A Condition Common to Many Disorders, J. A. M. A. **100**:1686 (April 8) 1933.
Newton, R., and Martin, W.: Canad. J. Research **3**:336, 1930.
Remeson, I., and Sepalowa, O.: Ztschr. f. d. ges. exper. Med. **77**:100, 1931.
Reznikoff, Paul: Treatment of Agranulocytosis with Adenine Sulphate, J. Clin. Investigation **12**:4553 (Jan.) 1933.
Ruskin, Simon L.: Sinusitis in Children, Am. J. Dis. Child. **36**:1020 (Nov.) 1928.
——The Mechanisms of Nephrosis in Sinusitis in Children, Acta paediat. **16**:249, 1933.
Straus, H.: Med. Klin. **17**:20, 1921.
Tichomiroff, T.: Ueber die Fällung von Toxalbuminen durch Nucleinsäure, Ztschr. f. physiol. Chem. **21**:90, 1895.
Wedgwood: M. Bull. Univ. Cincinnati, no. 13, 1924, p. 48.
Wells, H. G.: Chemical Pathology, Philadelphia, W. B. Saunders Company, 1925, p. 311.
Williams, J. L., and Dick, G. F.: The Excretion of Nonprotein Nitrogen Substances by the Intestine, J. A. M. A. **100**:484 (Feb. 19) 1933.
Williams, R. R.: J. Indust. Eng. Chem. **13**:1107, 1921.

Clinical Notes

GENERALIZED MENINGITIS OF OTITIC ORIGIN; USE OF FORCED SPINAL DRAINAGE IN TREATMENT

Report of a Case

WILLIAM BREWSTER ALLAN, M.D., NEW YORK

By generalized meningitis I refer to that form in which organisms are obtained in culture from the spinal fluid. Such a condition is often met and, except in the epidemic type, the outcome is unfortunately almost invariably fatal. Cases of meningitis in which the organisms are obtained only from the spinal fluid in smears offer a very different prognosis from those in which the organisms are grown in culture.

The case reported here is of interest because of recovery following an attack of generalized meningitis.

REPORT OF CASE

In M. P., a girl of 13 years, acute otitis media on the right side developed on Feb. 10, 1934, at which time a myringotomy was performed. There had been no previous trouble with the ears or other serious illness. The ear continued to discharge, and the patient was admitted to the Manhattan Eye, Ear and Throat Hospital. Eight days later a second myringotomy was done because of pain and a rise in temperature to 104.2 F. Symptoms of acute mastoiditis quickly developed, and on February 21 a simple mastoidectomy was done. Most of the cells contained pus, but there was neither pathologic nor surgical exposure. There was nothing unusual about the findings at operation or the immediate postoperative course. The patient left the hospital on March 8, the fifteenth postoperative day. She was treated in the office until March 18, at which time the posterior wound was almost healed and the middle ear was practically dry. The recovery up to this time appeared satisfactory.

On March 20, twenty-seven days after the simple mastoidectomy, the patient awakened at the usual time but complained of frontal headache which rapidly became worse. She was seen at 5 o'clock that evening, and she then complained of severe headache and stiffness of the neck and lower extremities. Her temperature was 103.8 F. On examination a seropurulent discharge was found in the right auditory canal, and there was tenderness over the mastoidectomy wound. A small amount of pus was escaping from the lower end of the incision. Hearing was good; there were no labyrinthine symptoms, and examination of the eyegrounds gave negative results. The patient's neck was rigid, and a bilateral Kernig sign was present. She was returned to the hospital, and a spinal tap was done and about 20 cc. of cloudy fluid under considerable pressure was removed. At 8 o'clock that evening the mastoidectomy cavity was reopened. Scar tissue had formed somewhat, and the granulations appeared healthy except in the region of the aditus, where they were definitely discolored. All the new-formed tissue

Read before the Section of Otolaryngology at the New York Academy of Medicine, Feb. 20, 1935.

was cleared away. Although the sinus and dural plates appeared healthy, they were removed, but no epidural abscess was seen. The capillaries of the dura were definitely injected, and the dura appeared somewhat tense and slightly gray. The posterior wall of the canal was then taken down, and the incus and malleus were removed from the surrounding granulation tissue, which was not healthy in appearance. The incision was enlarged, and the dural exposure was carried forward until the roof of the middle ear was removed. In this region the bone was definitely softened. It was curetted away, leaving an exposure just beyond the limits of the roof of the middle ear where the dura appeared more healthy. At no time was a purulent exudate noted on the dura. The dura was not incised or otherwise disturbed. The cavity was packed open with iodoform gauze.

The first specimen of cerebrospinal fluid contained 3,500 cells per cubic millimeter. There were 93 per cent polymorphonuclear leukocytes and 7 per cent small lymphocytes. Culture of the cerebrospinal fluid on a blood agar plate at the end of a period of incubation of thirty-six hours showed a positive growth of many colonies of long-chained hemolytic streptococci.

On the first postoperative day the patient was delirious and the temperature remained between 104 and 105.8 F. There was no change in the neurologic findings. On the morning of the second postoperative day the temperature dropped to 102 F.; the patient was no longer delirious, and there was definite improvement in the neurologic findings. However, after the report of the positive growth of hemolytic streptococci, it was decided to start forced spinal drainage, although there was definite clinical improvement.

With the help of Dr. C. C. Hare, about 90 cc. of cerebrospinal fluid was removed through lumbar puncture, and about 1,200 cc. of a hypotonic (0.5 per cent) solution of sodium chloride was given intravenously over a period of nearly three hours. During the afternoon the patient's temperature reached 104 F.

The results of examination of the second specimen of cerebrospinal fluid were as follows: albumin, moderate trace; globulin, no increase; sugar, normal amount; lactic acid, trace; total number of cells, 775 per cubic millimeter; polymorphonuclear leukocytes, 76 per cent; small lymphocytes, 22 per cent. Many streptococci were found on the smear. The culture was positive after twenty-four hours. The specimen showed one colony of hemolytic streptococci on the plate.

On the third postoperative day the temperature remained between 103 and 103.8 F. There was no change in the neurologic findings except that Babinski's sign, which was present on the preceding day, had disappeared. Forced drainage again was started, and about 45 cc. of cerebrospinal fluid was withdrawn. Because of hematoma intravenous injection of a solution of sodium chloride could not be given. The results of examination of the third specimen of cerebrospinal fluid were as follows: albumin, moderate trace; globulin, no increase; sugar, normal amount; lactic acid, trace; total number of cells, 220 per cubic millimeter; polymorphonuclear leukocytes, 55 per cent. The results of smear and cultures were negative.

On the fourth postoperative day the temperature remained between 100.6 and 103.6 F. There was decided improvement in the appearance of the patient. A bilateral Kernig sign was still present, but the rigidity of the neck had practically disappeared. Forced drainage again was begun, and about 50 cc. of cerebrospinal fluid was removed, during which time 1,500 cc. of a 0.5 per cent solution of sodium chloride was injected intravenously over a period of about two and one-half hours.

Examination of the fourth specimen of cerebrospinal fluid gave the following results: albumin, moderate trace; globulin, no increase; sugar, normal amount; lactic acid, trace; total number of cells, 254 per cubic millimeter; polymorphonu-

clear leukocytes, 74 per cent; small lymphocytes, 26 per cent. From a pellicle seen floating in the fluid many streptococci were obtained on smear. The results of culture were negative.

On the fifth postoperative day the patient showed continued improvement. The temperature remained between 100 and 102 F. There were no complaints, and the neurologic findings were normal except for a slight bilateral Kernig sign. A culture from blood obtained on the preceding day was negative. It was thought advisable to drain the spinal canal again, and 60 cc. of fluid was removed and about 1,500 cc. of a 0.5 per cent solution of sodium chloride introduced intravenously over a period of nearly three hours. The report of the examination of the fluid obtained from the fifth spinal tap was as follows: albumin, normal; globulin, negative; sugar, normal amount; total number of cells in the first 20 cc., 560 per cubic millimeter; in the remaining 40 cc., 320 per cubic millimeter; polymorphonuclear leukocytes, 49 per cent; small lymphocytes, 51 per cent. On smear, a few gram-positive cocci arranged in pairs were noted. The results of culture were negative.

Because of the improved condition of the patient, it was decided to omit spinal drainage on the following, or sixth postoperative, day. However, on the seventh postoperative day 50 cc. of spinal fluid was removed and 1,500 cc. of a 0.5 per cent solution of sodium chloride introduced intravenously. The report of the examination of the sixth specimen of spinal fluid was as follows: albumin, normal; globulin, negative; lactic acid, slight trace; total number of cells, 32 per cubic millimeter; polymorphonuclear leukocytes, 15 per cent. On smear, occasional gram-variable cocci in pairs and short chains were obtained. The results of culture were negative.

Although the condition of the patient was good, there occurred during the afternoon on which the last spinal drainage was performed a change in the pulse rate in the form of skipped beats. No further drainage was done. It may be mentioned that during the latter part of each spinal drainage the patient complained of violent headache which was controlled by the insertion of the stilet into the spinal needle for a moment or so. The mastoidectomy wound healed, and the temperature gradually returned to a normal level. The patient was discharged from the hospital on April 20.

How valuable spinal drainage was in this case is hard to say, for it will be noticed that there was a marked clinical improvement during the thirty-six hours after the exploratory operation before drainage was started.

The patient has been seen at intervals until the time of this report. The ear is dry; the loss of hearing for speech is approximately 58.4 per cent, and she has remained normal in every respect.

ADDITIONS TO THE COMPLETE OPERATION ON THE FRONTO-ETHMOSPHENOID SINUSES

FERRIS SMITH, M.D., GRAND RAPIDS, MICH.

The method for the provision of a frontal duct for adequate ventilation and drainage is the weakest point in the surgical technic of the complete external operation on the fronto-ethmosphenoid sinuses.

I prefer covering the exposed periorbita and cut edge of the nasal process of the maxilla with epithelium as the simplest and most certain means of accomplishing this.

I have advocated[1] applying this graft over a rubber tube inserted into the frontal sinus. The small surface of periorbita tangent to the largest tube which can be safely inserted does not furnish a sufficiently broad surface for growth in a small percentage of cases. The contraction of the graft into a cord during the process of healing defeats it purpose.

Fig. 1.—Inflatable rubber pad.

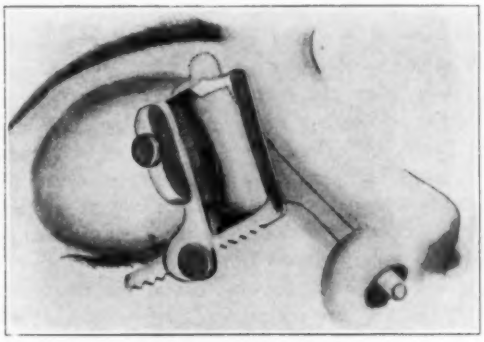


Fig. 2.—The pad in use.

A larger surface must be covered with epithelium. This is readily accomplished by utilizing the inflatable rubber pad (fig. 1) in the manner illustrated in figure 2.

The pad furnishes the required pressure for the adhesion of the graft. It expands "on the flat" rather than spherically. The projection on the bag is inserted into the infundibulum of the frontal sinus. The flat surface is lubricated and covered with split skin, with the raw surface exposed, and is approximated to the periorbita in the area of the removed lamina papyracea. This prevents adhesion of the periorbita to the cut surfaces of the bone and consequently it prevents obstruction of frontal ventilation and drainage. The bag may be used repeatedly.

1. Smith, Ferris: Management of Chronic Sinus Disease, Arch. Otolaryng. **19**:157 (Feb.) 1934.

A METHOD OF EMBEDDING TEMPORAL BONES

E. W. Hagens, M.D., Chicago
Friedberg Fellow in Otolaryngology, Department of Otolaryngology, Rush Medical College, University of Chicago

Because of its simplicity and of the good results obtained, the method of embedding temporal bones described here was deemed worth reporting. The technic was suggested by Dr. R. R. Bensley of the department of anatomy, and through his helpful guidance the practical application of the method was carried out.

The temporal bones are fixed, cut down to the desired size, decalcified and dehydrated in the usual manner. When the specimens are in equal parts of absolute alcohol and ether they are ready to be transferred to the embedding solution. This solution is made up as follows: Fifteen grams of pyroxylin (nitrocellulose) (one-half second, Hercules Powder Company, Gillespie, N. J.) is dissolved in 50 cc. of amyl acetate, making a solution of approximately 30 per cent concentration. This is diluted to about 6 per cent by the addition of 180 cc. of ether and 20 cc. of acetone. The bones (one pair) are placed in a tightly corked wide-mouthed bottle containing the final 6 per cent solution, and they are left undisturbed for two weeks, at the end of which time the cork is removed and only partly replaced. During the following two weeks the cork is gradually removed so that by the end of about fourteen days the embedding solution has evaporated to somewhat more than 30 per cent concentration. Apparently no harm results if this process of evaporation takes three weeks instead of two. When the process of evaporation has reached the desired point the consistency of the solution is still more liquid than that of ordinary pyroxylin (celloidin) at the stage when the specimens are removed. However, infiltration is stopped at this point. Weighted paper cups, or paper wound about blocks to make cups, are prepared. The bones are removed from the bottle with forceps and placed in the cups. The remaining pyroxylin is poured into the cups until the bones are properly covered. The specimens are then placed in chloroform and left for twelve hours, after which the chloroform is changed daily for four days. The paper cup is usually removed the first or second time the chloroform is changed. On being removed from the chloroform the specimens are ready to be mounted and cut. When they are not mounted immediately they are kept in equal parts of 95 per cent alcohol and glycerin. No change in the consistency of the pyroxylin has been noted in preparations kept for some months.

Temporal bones prepared in this manner are well embedded in unusually clear transparent pyroxylin and can be cut easily. The pyroxylin does not take up hematoxylin or eosin, and it is not seen on examination of stained preparations.

In summary it may be said that the technic is simple and easy, as it does not require any handling during the process of embedding. The time is also short for work with temporal bones. The bones are embedded in a clear transparent pyroxylin, and the landmarks are as easily seen as when a gross specimen is examined. Hence orientation and mounting of the bone for cutting are extremely simple and easy. The fact that the pyroxylin does not take up the stains is a great advantage in the microscopic study of the stained specimens. The method is not limited to work with temporal bones but may be used for other material.

REPAIR OF AN INJURY TO THE DURA OF THE MIDDLE CRANIAL FOSSA WITH VIABLE MUSCLE

O. JASON DIXON, M.D., KANSAS CITY, MO.

In the course of a decompression of the dura of the middle cranial fossa for a localized pachymeningitis complicating a chronic mastoid infection, a bone fragment was accidentally broken off the inner table, and a triangular tear was made through the dura.

Fortunately, this happened at the completion of the operation, after a wide posterior incision had been made, leaving the posterior segment of the temporal muscle exposed. Clear spinal fluid pulsated freely through the accidental opening, and as it was promptly recognized, no gauze or any instruments came in contact with the perforation in the infected field. A segment of temporal muscle was dissected free, but was left attached above. This viable muscle was firmly held over the dural opening, by finger pressure for three minutes, and the overlying periosteum and soft tissue were then tightly sutured.

The wound healed by primary intention, without suppuration, and the patient made an uneventful recovery and is not aware of the accident.

The bone was dry and brittle, and the inner table fractured from a hard blow of the gouge. The perforation was triangular, with each side about 0.5 cm. in length. Apparently the brain substance and the pia and arachnoid were not injured. The opening might have been closed by suture, but this would have contributed additional trauma and would have left a foreign body in the infected field.

Certainly, it would have been inadvisable to pack the mastoid wound with gauze. Viable muscle was available, and as it readily attaches itself to the dura (as I have shown repeatedly in experiments on the brains of dogs [1]), this tissue served admirably in immediately and completely closing the dural wound and avoiding further disturbance to the normal healing processes. Closure of the overlying soft tissues helped to fix the muscle in a permanent position.

730 Professional Bldg.

---

1. Dixon, O. Jason: The Application of Viable Muscle in Vascular Injuries, Ann. Otol., Rhin. & Laryng. **43**:1055 (Dec.) 1934.

Progress in Otolaryngology

A Summary of the Bibliographic Material Available in the Field of Otolaryngology

THE PARANASAL SINUSES

SAMUEL SALINGER, M.D.
CHICAGO

During 1934 a number of interesting publications appeared, mostly from American sources, dealing with the physiology of the nasal mucosa and its protective function. The work begun by Hilding, Proetz, Fenton and others is just now being noted in foreign countries, and one may soon expect to see the foreign literature deal with this subject more fully than in the past. In the French and Italian periodicals one finds numerous discussions concerning retrobulbar neuritis, from which it appears that the question is still unsettled. The American literature is considerably more concerned about sinusitis in children than is the foreign literature, and the opinions as to diagnosis and treatment are becoming more uniform. Malignant processes of the sinuses hold the attention of authors both here and abroad, and the reports from the larger clinics seem to indicate that the combined use of surgical intervention, diathermy and radium has been achieving much better results than any of these methods alone.

ANATOMY, EMBRYOLOGY AND HISTOLOGY

Schwartz [1] studied 150 human embryos as well as a number of fetuses of heifers of various ages with the idea of determining the formal genesis of turbinal bones, meatuses and ethmoid cells. He calls attention to the fact that the turbinal bodies are not primary but secondary to the active ingrowth of epithelium forming the meatuses. He spends much time and space explaining the manner in which the principal horizontal folds divide into the deeper clefts and succeeds in showing that the principle is one of asymmetric dichotomy which parallels the development of the lungs; i. e., after the first division takes

1. Schwartz, M.: Entwicklung der Nasennebenhöhlen und individuelle Varianten der Pneumatisation beim Menschen, Ztschr. f. Hal-, Nasen- u. Ohrenh. **36**:296, 1934; Zur Entwicklung des Siebbeines: Synthetisch-morphologische Untersuchungen zur formalen Genese, Beitr. z. prakt. u. theoret. Hals-, Nasen- u. Ohrenh. **31**:16, 1933; **31**:183, 1934.

place one of the new branches divides again before the other, thus making three branches. This manner of division continues in the heifer and other vertebrates having numerous meatuses and turbinals so that the sum of the branches at any level always equals the total of the two previous divisions. In other words, the number of branches would be as follows: 1, 2, 3, 5, 8, 13, 21 and so on. The author explains the formation of the ethmoid cells and their irregular number and form as being due to three main factors:

1. Foremost through the form of the ethmomere and the regular division of meatuses according to the rule of asymmetric dichotomy.

2. The presence of numerous adventitious buds arising from the apexes of the epithelial folds similar to the development of buds in the epithelium of the pancreas. (These give rise to numerous cells which occupy the original intermeatal walls and even invade the turbinal bones.)

3. The outer boundaries of the ethmoid capsule which limit the growth of the cells and cause them to grow in various directions away from their point of origin, thus giving rise to irregularity in their form and the location of their ostia. As the division of the meatuses proceeds toward the periphery the stems become shorter, the rhythm of division is hastened so that eventually instead of new meatuses only spaces remain, and these spaces are the ethmoid cells. The cells, therefore, are to a large extent the termination of multiple passages which have resulted from a varied number of rapidly succeeding but incomplete divisions of the primary meatuses. Variability among individual subjects is dependent on or inherent in the hereditary character of the mucosa. Its potentiality varies in the same manner as the mucosa of the spaces of the middle ear.

Along these same lines Haas [2] ascribes aplasia or hypoplasia of the frontal sinuses to infection in infancy, basing his assumption on Witmaack's theory of pneumatization of the mastoid process. As these sinuses do not develop normally up to the fourth year of life, they differ from the other sinuses in their susceptibility to inhibited growth. The other sinuses, being already present at birth, are less likely to be influenced in their growth by early infections.

Sitzen [3] studied numerous skulls, taking various dimensions in order to determine whether there is any definite ratio between the size of the skull and the development of the frontal sinuses. He could find no

2. Haas, L.: Ueber Entwicklung und Nichtentwicklung der Nasennebenhöhlen, Monatschr. f. Ohrenh. **68**:1080, 1934.

3. Sitzen, A. E.: Ueber den Zusammenhang zwischen Glabella und Stirnhöhlen, Ztschr. f. Anat. u. Entwicklngsgesch. **103**:384 (Oct.) 1934.

correlation in these dimensions. He found, further, that after birth the lower part of the frontal bone in the region of the glabella becomes thickened owing to an increased formation of bone on both the anterior and the posterior plates, the intervening space being filled with cancellous bone. The thickening on the posterior half leads to the formation of the crista frontalis. This thickening is found before the frontal sinus develops and attains more marked size in those cases in which a frontal sinus does not appear. The development of the glabella similarly is as great in cases in which there is no frontal sinus as in those in which this space is present. The author therefore concludes that there is no basis for the assumption that the plates of the sinuses are forced apart through the development of the sinus but rather that the sinus grows into a frontal bone that is already developed. He expresses the belief that the thickening of the posterior wall is due to the tension of the falx cerebri. The growth and thickening of the anterior plate are due to development of the upper jaw and the stimulus resulting from the act of chewing.

Shea [4] ascribes the persistence of infantile sinuses in adults to arrested development as a result of infections in early childhood. He also points out the influence of heredity, having seen children who showed the same type of sinuses as the parent. Infantile sinuses in adults are recognized by small turbinate bodies with crusting and by the roentgen findings which show rudimentary frontal sinuses, few ethmoid cells and small sphenoid cells with very thick walls. Arrested development of the maxillary sinuses will often prevent eruption of the second and third molars.

The nasofrontal duct was investigated in 22 specimens (43 nasofrontal ducts) by Alexandre.[5] He took roentgenograms after filling the duct with contrast mediums and passing sounds. The skulls were then sectioned to show the duct in its entire course. In 25 per cent the canal coursed from above anterior to below posterofrontally in the lateromedian sense. This appears to be the typical direction when the canal is long and regular. In 1 specimen the duct ended blindly in a cell which had another opening a little higher leading downward. The length varied up to 20 mm. In 7 of the 43 ducts the canal was absent and the floor of the frontal sinus, which was very wide, opened directly into the nasal cavity. In 1 case the canal ended abruptly at a bony diaphragm which shut off the sinus completely from the nasal cavity. The typical average canal is from 10 to 15 mm. long, oval, with a diameter from 2 to 4 mm.

4. Shea, J. J.: Normal and Pathological Development of the Sinuses, Pennsylvania M. J. **37**:279 (Jan.) 1934.

5. Alexandre, A.: Contributo allo studio del canale naso-frontale nell'uomo, Otol. rino-laring. ital. **4**:156, 1934.

It runs diagonally backward and downward in the median (sagittal) plane. In 30 per cent of the cases the canal did not make its exit from the lowest point in the floor of the sinus. Varying morphology explains some cases of chronic sinusitis, because various conditions exist which prevent adequate drainage. Alexandre makes the important observation that in 48 per cent of the cases the contrast mediums ran down into the maxillary sinus. He expressed the belief that the typical duct indicates typical development of the sinus from the frontal cavity while atypical forms indicate origin from an ethmoid cell. In 1 specimen there were two frontal sinuses superimposed on one side.

Latta and Schall [6] obtained mucosa from the sinuses of fresh cadavers for which there was no history of previous infection and compared the histologic observations with those on specimens from the calf, dog, rabbit and cat. The simplest type of mucosa found was a columnar ciliated epithelium with occasional basal cells. Both in man and in domestic animals they found many instances in which the relative number of undifferentiated basal cells was increased so that the epithelium was pseudostratified, either columnar or cuboidal. There were relatively few goblet cells, and the superficial layers were ciliated in practically all instances. Such epithelium in the maxillary and sphenoid sinuses was found associated with a thin underlying connective tissue stroma.

In the maxillary sinus under conditions of acute irritation Latta and Schall found an increase in the basal cells with a tendency to differentiation. The cells became more closely packed, and the epithelium appeared truly stratified. The proportion of goblet cells was not materially increased. Hyperplastic epithelium of this sort was always associated with an underlying stroma infiltrated with numbers of macrophages, polymorphonuclear leukocytes and lymphocytes.

In other specimens (mostly from ethmoid and a few frontal sinuses) the epithelial hyperplasia showed large numbers of goblet cells in the superficial layers. In some cases the ciliated epithelium was compressed; in others the surface was almost entirely goblet cells. The origin of these cells is principally from the undifferentiated basal cells. These cells secreting mucin eventually disintegrate. This type is usually associated with a dense underlying stroma and indicates either a chronic irritative condition or the reparative stage of an acute condition.

Latta and Schall conclude that regeneration of epithelium apparently proceeds from the irregularly cuboidal undifferentiated basal cells which are not involved in any degenerative sloughing process unless

6. Latta, J. S., and Schall, R. F.: Histology of the Epithelium of the Paranasal Sinuses Under Various Conditions, Ann. Otol., Rhin. & Laryng. **43**:945 (Dec.) 1934.

conditions are very severe, and then only part of them are affected. They possess the power of forming either ciliated or goblet cells, depending on the environmental stimulus.

PHYSIOLOGY

Proetz [7] conducted a number of experiments on living animals and on mucosa from human sinuses. Specimens of the latter were spread on glass tubes through which water of the desired temperature was kept flowing. Proetz employed thermocouples to correct for slight amounts of heat reaching the surface of the specimen from the illumination. The object of the investigation was to show the effect on ciliary activity of heat and cold, cocaine of various concentration, ephedrine, epinephrine and drugs such as menthol and merthiolate. Proetz found that drying the mucous membrane causes a slowing of the ciliary beat as a result of increased viscosity of the mucous blanket, thus favoring the entrance of bacteria. Cocaine in solutions over 2 per cent causes cessation of the ciliary beat for periods of greater or less duration, depending on the concentration. Epinephrine in a solution of 1 : 1,000 stops the ciliary activity without subsequent resuscitation, whereas a solution of 1 : 5,000 impairs the ciliary function after twenty-five minutes. The optimum temperature for ciliary activity was found to be between 28 and 33 C. As the temperature is reduced the motion becomes slower until it ceases at from 7 to 12 C. Motion can be restored by warming. When the temperature is slowly raised to 43 C. all motion ceases, and it cannot be restored by cooling.

The important conclusions reached by Proetz are that bacteria do not gain entrance to the tissues unless the mucous layer becomes dry and viscous and the ciliary beat is slowed. Anatomic deformities have something to do with predisposition to this condition. The author expresses the opinion that infection enters more readily through mucosa in which the cilia have been suddenly incapacitated than through thick hyperplastic areas which are relatively impervious. He found vigorously functioning cilia in the midst of extreme hyperplasia and pus, thus somewhat contradicting former conceptions of chronic sinusitis. Furthermore, he corroborates a previous assumption that normally functioning ciliated epithelium in the maxillary sinus is regenerated following its complete extirpation, which again removes one of the objections to the radical operation on the antrums.

Similar experiments conducted by Negus [8] with special reference to the p_H concentration of various solutions brought out the fact that

7. Proetz, A. W.: Nasal Ciliated Epithelium, with Especial Reference to Infection and Treatment, J. Laryng. & Otol. **49**:557 (Sept.) 1934.

8. Negus, V. E.: The Action of Cilia and Effect of Drugs on Their Activity, J. Laryng. & Otol. **49**:571 (Sept.) 1934.

when the p_H was lowered to 6.4 or less, ciliary action ceased, as contrasted with vigorous activity after twenty-four hours with concentrations of 8.5 per cent. The studies were made with solutions of sodium chloride, sodium acetate and Tyrode's solution with a p_H varying from 9 to 4.

Lierle and Moore [9] also tested the reaction of the cilia to various medicaments with the following results:

1. Tap water and distilled water when applied to the mucosa of the upper respiratory tract cause a slowing of the ciliary beat.

2. A 3 per cent solution of ephedrine hydrochloride is not detrimental and at times increases the ciliary activity.

3. A 5 per cent solution of cocaine does not impair the ciliary activity, but solutions of greater strength slow the beat. Recovery, however, is usually prompt.

4. Mild silver protein in solutions up to 20 per cent causes an initial increase with subsequent slowing, probably due to the water solvent.

5. One per cent menthol, thymol and eucalyptol are depressing.

6. Epinephrine in a 1:1,000 solution, a 2 per cent solution of zinc sulphate and a 2 per cent solution of mercurochrome are definitely detrimental in the order named.

7. Silver nitrate in a 0.5 per cent solution is immediately and fatally detrimental to ciliary activity. In no instance was it possible to revive it after the application of the drug.

Larsell and Fenton,[10] experimenting with the frontal sinus of cats, induced chronic sinusitis by inoculation with human hemolytic streptococci. After the sinusitis had existed for six weeks they injected foreign protein intramuscularly and into the sinus itself and found that it produced an acute exacerbation and pericapillary infiltration with round cells and histiocytes. The effects were similar to the usual reparative changes seen after the use of autogenous vaccines.

The lymphatic channels in the submucosa seemed to converge near the normal ostium and became more or less clogged with histiocytes and polymorphonuclears, thus causing local edema with mechanical obstruction to drainage.

Unilateral cervical sympathectomy on cats with bilateral chronic sinusitis caused active reparative congestion in the sinus of the same side while the opposite sinus remained unchanged.

---

9. Lierle, D. M., and Moore, P. M.: Effect of Drugs on the Ciliary Activity of Mucosa of the Upper Respiratory Tract, Arch. Otolaryng. **19**:55 (Jan.) 1934.

10. Larsell, O., and Fenton, R.: Further Research on Experimental and Clinical Sinusitis, Arch. Otolaryng. **20**:782 (Dec.) 1934.

The use of antiseptic solutions (merthiolate in a 1 : 1,000 solution, chloramine in 1 : 3,000 solution, and a 0.5 per cent solution of trinitrophenol) followed immediately by a 0.5 per cent solution of calcium gluconate and 95 per cent alcohol produced further loss of epithelium and invasion by polymorphonuclears, thus delaying healing. A 1 per cent solution of mercurochrome, metaphen in a concentration of 1 : 5,000 and a 0.5 per cent solution of oxyquinoline sulphate emulsified with 0.5 per cent scarlet red seemed to promote infiltration with histiocytes and round cells to a limited extent without, however, improving the tendencies to repair.

Roentgen treatment may produce fibrosis but will not prevent infection. Exacerbations have taken place in 10 patients receiving such treatment. Diathermy twice weekly for one month in cases of bilateral chronic maxillary sinusitis produced rapid clinical amelioration in each. In such cases tissue subsequently removed and examined showed recent hyperemia with histiocytes and some fibrous repair.

In an earlier communication Fenton [11] reported that in these cases of sinusitis experimentally produced in cats accurately regulated diets of varying chemical and vitamin content had little or no effect either pathologically or clinically. Intradermal vaccination was also of no avail, although it seemed to produce areas of acute local exacerbation. Irradiated hydrocarbon oils were useless because they clogged up the ciliary movement and interfered with the flow of mucus.

Calcium therapy for man when given orally, intravenously and by irrigation seemed to reduce edema, favor phagocytosis and increase the accumulation of plasma cells leading to fibrosis.

Fenton expresses the belief that the histiocytic system offers the earliest defense, especially in cases of acute sinusitis or of acute exacerbation of chronic sinusitis, and that the plasma cells are found in the later stages of practically every type of inflammation and repair.

MacMahon [12] studied the effects of ionization on the mucosa of the frontal sinus of dogs. He used amytal intraperitoneally for anesthesia and opened the sinus externally. The nasofrontal duct was blocked with paraffin. The sinus was then filled with a solution (zinc electrodes were used with zinc solution [2 per cent] and platinum electrodes with the other solutions) : a 0.1 per cent solution of India ink suspended in saline solution, a 10 per cent solution of neo-silvol (a colloidal solution containing 20 per cent silver iodide) and a 10 per cent solution of mild silver protein (a colloidal solution containing 20 per cent silver).

---

11. Fenton, R.: Histopathology and Clinical Interpretation of Experimental Sinus Disease, Arch. Otolaryng. **19**:183 (Feb.) 1934.

12. MacMahon, B. J.: Effects of Ionization on the Mucosa of Frontal Sinuses of Dogs, Ann. Otol., Rhin. & Laryng. **43**:643 (Sept.) 1934.

A current of 5 milliamperes was applied for twenty minutes, with both sinuses being filled and one electrode in each sinus. The dogs were killed, and the mucosa was removed and studied.

The zinc solution caused destructive changes, viz: "ballooning, fragmentation and complete destruction of surface epithelium, a marked edema of the subepithelial tissues and an extravasation of free red blood cells into the tissues from greatly dilated and ruptured capillaries. . . . The specific response to ionization with silver colloids is a polymorphonuclear leucocytosis. The general response of the mucosa of the frontal sinus to a galvanic current is an engorgement of the capillaries of the subepithelial tissues." MacMahon cannot say definitely that "ionization has any advantage over passive contact within a cavity lined with mucous membrane in so far as the local tissue reaction is concerned. The ionizable solution may react spontaneously to the electrical forces of the tissues themselves when contact is made for a sufficient length of time and thus enable the constituent ions to penetrate into the mucosa and instigate an appropriate reaction." He states further that bacterial activity is controlled as much by the leukocytosis as by the nascent ions set free. He particularly emphasizes the destructive action of the zinc solutions in his experiments.

HEREDITY

An interesting study of a family of three generations in which there was a high incidence of disease of the sinuses was made by Grunberg.[13] The grandfather suffered from chronic sinusitis from twenty-five to thirty years. Eight of his eleven children were similarly affected, the age of onset being from the seventeenth to the thirty-fifth year. Eight of twenty grandchildren had sinusitis at the average age of 14.5 years. This "anticipation" phenomenon has been noted before in human pedigrees; i. e., inherited diseases develop in later generations at an earlier age. The influence of climate in this study can be disregarded because the children and grandchildren were scattered throughout a number of cities and towns with varying climatic conditions. The hereditary influence was particularly striking in view of the fact that the descendants of a brother of the original patient were free from evidence of disease of the sinuses.

Grunberg believes that the unusual disposition to inflammatory diseases of the sinuses in the family was due to an irregularly dominant gene.

---

13. Grunberg, H.: The Inheritance of a Disease of the Accessory Nasal Cavities, J. Genetics **29**:367 (Oct.) 1934.

PATHOLOGY

Steinberg [14] examined mucous membrane from the sinuses of 3 patients who died of allergic asthma. He also studied tissue removed from 30 patients suffering from hay fever or chronic sinusitis. His findings in the true allergic cases are summarized as follows:

1. Hypertrophy and marked secretory activity of the mucous glands.
2. Presence of large amounts of mucus in the lumens.
3. Marked eosinophilia (from 15 to 90 per cent of all cells).
4. Edema of the tissue.
5. Thickening and hyalinization of the basement membrane.
6. Hyperplasia of the goblet cells with hypersecretory activity.

Steinberg claims that the histopathology of the entire respiratory tract, including the sinuses, in cases of atopic allergy is characteristic and recognizable.

The effects of suspended nasal respiration in patients wearing a tracheal cannula were investigated by Menniti-Ippolito.[15] The absence of a respiratory current through the nasal passages leads to stagnation of secretions, hyperplasia of the mucosa, increased secretion, formation of a crust and polypoid degeneration. In 17 of 21 patients, most of whom were children, there were definite roentgen findings of stasis and clouding of the maxillary sinuses. Also, there was evidence of arrested development of the frontal sinuses.

Deilmann and Kutscher [16] refer to work done by Goedel, Kutscher and Schlander on the total nitrogen content of secretions of the middle ear in which it was shown that in those cases in which there was a tendency for the patient to get well spontaneously the nitrogen content remained low while in the cases in which the process was more malignant there was a high percentage of nitrogen with a tendency to increase. The authors attempted an analogous study in 6 cases of acute and 5 of chronic maxillary and frontal sinusitis. To prevent contamination of the secretion of the sinuses with that of the nasal chambers they either aspirated it directly through a trocar or sucked it out of the nose after previously cleansing the nasal cavity by irrigation. They found in the acute cases that the total nitrogen content varied from 1 to 9 per cent.

---

14. Steinberg, B.: Recognition of the Allergic State by Tissue Examination of the Respiratory Tract and the Nasal Sinuses, Am. J. Clin. Path. **4**:169 (March) 1934.

15. Menniti-Ippolito, R.: L'esame radiografico delle cavita accessorie del naso nei portatori di cannula tracheale, Arch. ital. di otol. **46**:617, 1934.

16. Deilmann, F. W., and Kutscher, E.: Ueber das Verhalten des Eiweisstickstoffes im Sekret bei akuten und chronischen Nebenhöhlenentzündungen, Ztschr. f. Hals-, Nasen- u. Ohrenh. **37**:165 (Dec.) 1934.

They suspected that the high percentage was due to stasis, but on establishing free drainage they discovered that the percentage of nitrogen remained unchanged. They could not draw a conclusion as to the value of this determination, especially in view of the fact that a subsiding infection did not show a corresponding decrease in the nitrogen content of the secretion. In the chronic cases the nitrogen content varied from 3 to 5 per cent. The fact that the range was narrower than that in the acute cases could only be taken to signify a balance between an infective agent and local resistance. The authors were forced to conclude that the prognostic value of the test was nil.

Miyake [17] claims to be the first to have studied the sulphur content of the secretions in cases of maxillary sinusitis. In the cases of chronic suppuration the percentages varied from 0.13 to 2.62. In the cases of chronic hyperplasia the sulphur content was extremely low. In cases of the mixed forms the percentage was higher, from 0.75 to 1.07. The sulphur content in cases of bilateral suppuration was approximately the same on the two sides.

Three cases of bony splinters found at operation in the maxillary sinuses were reported by three Japanese observers (Sasaki,[18] Hashimoto [19] and Muta [20]). The fragments looked like teeth, but on histologic examination they proved to be spongy bone tissue, which the authors believed developed by metaplasia from the periosteal lining of the sinus.

Eichhorn [21] presents a full discussion of concrements in the maxillary sinus on the basis of 13 cases reported in the literature, including 1 of his own. He expressed the opinion that the cause is an original mycotic infection with the mycelia affording a nidus for the development of the stone.

Dahl and Pugatsch [22] examined mucosa removed at operations on the maxillary sinuses, making separate studies of the tissue from each wall. They found the most advanced pathologic processes on the medial wall and floor. They distinguished three types of pathologic change: exudative, proliferative and mixed. Histologic studies often showed vacuolated cells, Russell bodies and loose connective tissue infiltrated with plasma cells, a picture very similar to that of rhinoscleroma. The authors doubt the necessity of completely removing all the mucosa

17. Miyake, H.: Ueber den Schwefelgehalt des Eiters der Kieferhöhle von chronischen Sinuitiden, Nagasaki Igakkwai Zassi **12**:909, 1934; abstr., Zentralbl. f. Hals-, Nasen- u. Orenh. **23**:495 (Nov. 10) 1934.

18. Sasaki, Y.: Otologia, Fukuoka **7**:425, 1934.

19. Hashimoto, M.: Otologia, Fukuoka **7**:512, 1934.

20. Muta, T.: Otologia, Fukuoka **7**:368, 1934.

21. Eichhorn, H.: Kieferhöhlenkonkremente, Dissert., Erlangen, 1934, p. 16.

22. Dahl, M. K., and Pugatsch, N. M.: Zur pathologischen Anatomie und Pathogenese der chronischen Highmoritiden, Vestnik soviet. otol. **27**:124, 1934.

because in most cases the pathologic changes did not indicate that the tissue was entirely beyond repair. Nevertheless, they report that only 50 per cent of their patients were cured.

BACTERIOLOGY

Wirth and Brander [23] found clinically healthy noses to be free from pathogenic organisms. In 257 cases of various types of rhinitis and sinusitis the pneumococcus was the most common organism, being present in 45.9 per cent. The influenza bacillus was present in 22.9 per cent of the cases, and the hemolytic streptococcus, in 15.2 per cent. Most frequently the infection was mixed, Bacillus influenzae being the organism most commonly associated. In cases of acute infection the organisms are generally present in pure culture. Specimens from patients with genuine chronic hypertrophic rhinitis or chronic serous sinusitis yielded no probable bacterial agents. The Abel bacillus was the most common organism found in cases of atrophic rhinitis.

As to prognosis, the authors believe that anatomic factors are more important than the infective agent. The hemolytic streptococcus and the anerobes were as a rule more malignant than pneumococci and B. influenzae. Sinusitis due to pneumococcus type III was found to be more common than suspected. Contrary to the experience in cases of infection of the middle ear, infections with Streptococcus mucosus were found to be less severe. Infection of the frontal sinus with B. influenzae gave rise to a thin mucoid secretion. This organism is a frequent cause of chronic frontal sinusitis and is commonly seen in mucoceles.

The first case of acute frontal sinusitis with enterococcic exudate was reported by Bronzini.[24] He obtained a cure by surgical intervention and the use of an autogenous vaccine.

Kelley [25] found Aspergillus fumigatus in 7 cases, in which it caused a discharge of a greenish, soft mass. The symptoms were those of unilateral vasomotor rhinitis, paroxysmal sneezing, profuse rhinorrhea and swelling of the inferior turbinate with neuralgia, if the antrum was involved, and with headache if the fungus was located in the nose. The discharge appeared at intervals from the affected side in the shape of shreds of white membrane or a tough green gelatin-like secretion, often with an offensive odor. Frequently a mass was found in the nose shut

23. Wirth, E., and Brander, E.: Die Beziehungen der Keimflora zum klinischen Befunde bei Rhinitiden und Sinusitiden mit besonderer Berücksichtigung der Pneumokokkentypen, Beitr. z. prakt. u. theoret. Hals-, Nasen- u. Ohrenh. **31**:345 (Aug.) 1934.

24. Bronzini, A.: Sinusite frontale acuto con essudato mucoso do enterococco, Boll. d. mal. d. orecchio, d. gola, c. naso **52**:27 (Jan.) 1934.

25. Kelley, A. B.: Aspergillosis of the Nose and Throat and Maxillary Antrum, J. Laryng. & Otol. **49**:821 (Dec.) 1934.

off by polypi or a hypertrophic middle turbinate. It was often difficult to wash out the antrum on account of the thick, slimy, membranous exudate. Kelley advises against forceful irrigation but recommends a window in the inferior meatus. If the diagnosis is established, a cure can be effected by a Caldwell-Luc operation. It is necessary to eradicate the organism completely because cases have been reported in the literature in which the fungus gained entrance to the cranial cavity, causing encephalitis and death.

Stevenson,[26] who wrote on mycosis in 1933, again reports cases of infection of the maxillary sinus with Mucor-Histoides. He claims that the fungus is the active agent and not merely a secondary saprophyte. In 5 cases the involvement was bilateral. The treatment should be as in other infections, dependent on the symptoms and pathologic process.

Pickworth [27] contributes a most interesting study of the bacteriology in cases of chronic sphenoiditis. Cultures from washings of the sphenoid sinus at the Birmingham Mental Hospitals showed chances of recovering bacteria to be 3 to 1. Of the organisms found, 40 per cent were streptococci, 50 per cent, staphylococci and 30 per cent, diphtheroids. In 8 cases small portions of bone were removed from the posterior wall of the sphenoid sinus under asceptic precautions. Only 2 of the specimens were sterile. Streptococci were present in 5, staphylococci in 4, B. influenzae in 2 and diphtheroids in 1. Several postmortem sections of bone from the sphenoid sinus were found to harbor attenuated streptococci deeply situated in the bone tissue. In another case a chain of streptococci was found below the surface of the epithelium showing irregular triangular or club-shaped bacteria irregularly spaced within the filament. Those more deeply located, as in the bone, showed an irregularity of the gram-positive elements in the filament so marked that unless the intermediate forms had been studied there would be difficulty in identifying them as streptococci. The author studied 200 cases by decalcifying thin slices of sphenoid bone in a 5 per cent solution of trichloracetic acid and saline solution and staining them with Gram's stain. In 40 per cent of the cases filaments containing gram-positive granules were found. Pickworth refers to the mutation of organisms as described by Dochez and others. He expressed the opinion that these altered bacteria may be reactivated under certain conditions and lead to complications in patients long thought cured. The filaments demonstrated in the bone represent bacteria the virulence of which has been inhibited through a high antibody content of the host but which nevertheless are responsible for chronicity of the disease of the sinuses.

26. Stevenson, H. N.: Mycotic Infection of Sinuses, Arch. Otolaryng. **20**: 340 (Sept.) 1934.

27. Pickworth, F. A.: Organisms in Chronic Bone Infections of the Sphenoid, Proc. Roy. Soc. Med. **27**:1509 (Sept.) 1934.

In children such a condition may lead to irregularities in the development of the sinus or may impede the physical growth or alter the social development of the child.

Watson-Williams, in commenting on Pickworth's paper, alluded to cases of Fröhlich's syndrome in boys in whom the sphenoid sinus was found infected. Cure of the infection led to favorable results.

DIAGNOSIS

Cytology.—Hansel [28] considers the cytology of nasal secretions important in the differentiation of the allergic from the infectious cases or in the diagnosis of the allergic element in doubtful cases. His observations are based on a study of secretions (5,000 specimens) in about 1,000 cases of allergy, often associated with asthma and other allergic diseases. These findings were correlated with bacteriologic and roentgen studies. He found the Giemsa stain most reliable, using 1 drop of stain diluted with 1 cc. of distilled water. He used 1.5 cc. of this for each slide, allowing it to remain for from twenty to thirty minutes. The method of identifying and recording the various cells is fully described. His conclusions are as follows:

1. A demonstrable number of eosinophils is presumptive evidence of allergy.

2. The presence of neutrophils in addition to eosinophils is an indication of a superimposed infection.

3. The eosinophilic-neutrophil proportion is the index of the nature of the disorder.

4. Repeated observations may enable one to differentiate acute from chronic infections.

5. "A pure eosinophilic response as the result of bacterial hypersensitiveness is not definitely substantiated on the basis of clinical evidence."

6. Cases of hyperplasia and polyposis with a persistent absence of a diagnostic number of eosinophils, as a rule, do not prove to be allergic.

In acute cases of coryza in nonallergic patients eosinophils may appear in the stage of resolution. Repeated smears to determine the presence of allergy show that in the nonallergic patients the eosinophils disappear before the neutrophils, and vice versa in allergic patients.

Roentgenology.—Dickson and Marquis [29] studied 68 cases with the idea of determining the value of contrast mediums used according to

28. Hansel, F. K.: Observations on the Cytology of the Secretions in Allergy of the Nose and Paranasal Sinuses, J. Allergy **5**:357, 1934.

29. Dickson, J. C., and Marquis, W. J.: Visualization of Accessory Sinuses by the Proetz Method, Arch. Otolaryng. **20**:188 (Aug.) 1934.

the Proetz method in diagnosis and comparing the results with information obtained from roentgenograms made without contrast mediums. Complete or partial filling was obtained in 90 per cent of all cases. They found the filling technic of most value in the frankly purulent cases. It was of least assistance in the questionable cases. "Lack of filling may or may not be indicative of a pathologic process. Therefore, great difficulty is experienced in properly interpreting or evaluating the sinuses that do not fill in borderline or clinically indeterminate cases. Plain roentgenograms should be made first. Confirmation by visualizing the sinuses by the Proetz method gives the greatest amount of satisfaction." The authors claim that the Proetz method was helpful in 29.4 per cent of their cases, of no help in 64.8 per cent and apparently incorrect in 5.8 per cent. They state that sinuses which cannot be examined by roentgen rays and which do not fill by the Proetz method are not to be considered pathologic unless there is corroborative clinical evidence.

Zuppinger [30] is enthusiastic about the Proetz technic of filling sinuses and expresses surprise that no mention is made of it in the Denker and Kahler "Handbuch der Hals- Nasen- Ohren- Heilkunde mit Einschluss der Grenzgebiete." He advises filling the maxillary sinus by puncture through the middle meatus. The procedure is of value in determining the condition of the mucosa and in outlining tumors. It is indicated in all cases of obscure infection and suspected new growths in the region of the hard palate, alveolar process and sinuses.

The technic of the roentgen examination of the sinuses with the patient in the four standard positions is fully described by Bell,[31] who uses the Bucky diaphragm in all but the fronto-ethmoid and axial sphenoid projections. As for contrast mediums, he believes that they are useful mainly in diagnosing pathologic processes in the maxillary sinus. A large number of illustrative roentgenograms accompany the article.

Sourice [32] suggests that roentgenograms of the maxillary sinus be made with the patient in the upright rather than in the horizontal position. He has shown that in some cases fluid in the sinus will change its level with the position of the head, which makes a difference in the picture. He also advises using iodized poppy-seed oil 40 per cent in doubtful cases.

---

30. Zuppinger, A., and Rüedi, L.: Zur Darstellung des Sinus maxillaris, des Epipharynx und der Trachea mit Kontrastmittel, Fortschr. a. d. Geb. d. Röntgenstrahlen **49**:176 (Feb.) 1934.

31. Bell, J. C.: The Roentgen Ray as an Aid in the Diagnosis of Disease of the Nasal Accessory Sinuses, Radiology **22**:521 (May) 1934.

32. Sourice, A.: Quelques notions nouvelles à propos de l'exploration radiologique des sinus, Arch. d'électric. méd. **42**:145, 1934.

Opaque oil was used by King [33] in studying the maxillary sinus before and after operation. Although a radical operation may have been indicated in some cases, the intranasal operation was performed in all. Six of the 12 patients are well both clinically and from the roentgenographic point of view. The other 6 do not have normal mucosa, although 3 are clinically well. An interesting observation by the author was that after filling the sinus only the excess of the solution drained out of the artificial opening while the remainder was later expelled through the natural ostium. In only 1 of 7 cases thus observed was drainage carried out completely by way of the artificial window. This finding bears out clinically what Hilding demonstrated experimentally. King concludes that in cases of marked polyposis and definitely hyperplastic mucosa the condition cannot be permanently cured by the intranasal window operation.

The form, size and position of the maxillary sinus at various ages were studied by Sedwick [34] by means of roentgenograms of the skull. His findings are summarized as follows:

1. The maxillary sinus varies greatly in size, shape and position not only in different individuals but on each side of the same individual.

2. The sinus reaches its maximum size during the third decade of life and does not increase thereafter.

3. In later decades there is a definite tendency toward the assumption of a triangular form.

4. When the sinus is triangular in form the position of its base varies.

5. The relation between the floor of the sinus and that of the nasal cavity varies and is not characteristic of sex.

The only difference between the sinuses of the white and those of the Indian skulls examined was that the vertical dimension was less in the Indian, a fact which might be correlated with the shorter nose and broader cheeks of this race. The average measurements for the sinus based on measurements of 173 skulls, or 346 sinuses, were as follows: height, 34 mm.; width, 25 mm. (maximum, 35 mm.; minimum, 17 mm.); anteroposterior length, maximum, 51 mm., minimum, 29 mm.

The diagnosis of conditions in the frontal sinus was thoroughly gone into by Regules and Caubarrere,[35] who sought to differentiate empyema, hypertrophy of the mucosa, periosteal swelling and involvement of

33. King, E.: Examination of Maxillary Sinus Before and After Operation, Arch. Otolaryng. **20**:842 (Dec.) 1934.

34. Sedwick, H. J.: Form, Size and Position of the Maxillary Sinus at Various Ages Studied by Means of Roentgenograms, Am. J. Roentgenol. **32**:154 (Aug.) 1934.

35. Regules, P., and Caubarrere, N. L.: Der klinische wert einiger Einzelheiten im Röntgenbild der Stirnhöhle, An. de oto-rino-laring. d. Uruguay **3**:218, 1934.

bone with the help of roentgenograms. If there is complete clouding of the sinus and the borders are clearly defined one must fill the sinus with iodized poppy-seed oil 40 per cent in order to determine definitely whether the mucosa is swollen. If the iodized poppy-seed oil proves that the mucosa is not swollen the indication is to establish intranasal drainage, as the shadow must be caused only by accumulated secretion. If the contrast mediums, however, show a definitely thickened membrane the prognosis is not so good, and in cases of a chronic condition one has to decide whether an intranasal or an external operation is indicated. If the roentgenogram shows a blurring of the outlines of the sinus it indicates involvement of the bone and an external operation is required. If the sinus is cloudy and its boundaries are obscured at all points one may deduce that there is either an acute fulminating infection of the sinus or protracted chronic infection with involvement of bone. Furthermore, it is also possible that such a picture might indicate a previously infected sinus now inactive. The treatment would depend on the history and clinical findings. One would either have to open the sinus externally or wait, the amount of pain and other local symptoms being the determining factors.

Mayer [36] describes 4 cases of anomalies in the position of the planum sphenoidale, in only 1 of which the condition was strictly developmental. It was a case of so-called pneumosinus sphenoidalis. The planum was markedly bulged through an unusually extensive pneumatization of the sinus which extended into the lesser wings. The latter appeared as though they were inflated. In a case of an overlying meningioma pneumosinus was associated with hyperostosis of the planum sphenoidale. The diagnosis of tumor was based on the hyperostosis while the bulging of the planum was considered an anomaly. In a third case the planum was placed low on account of marked intracranial pressure, and in the fourth case the planum was bulged by a cystic tumor of the sphenoid sinus. At the same time the floor of the sella turcica was completely destroyed.

Miscellaneous.—Simon,[37] employing the antroscope for diagnosis, found that the canine route offers 20 per cent more visibility than the inframeatal route; however, there is not enough difference to offset the greater severity of the procedure. Besides, the "blind" area of the canine route happens to include the natural ostium which one should see in 70 per cent of all cases in which examination is made through an inframeatal opening. Simon's studies of the ostium showed it to be a

36. Mayer, E. G.: Ueber Lageanomalien des Planum sphenoidale und ihre diagnostische Bedeutung, Röntgenpraxis **6**:427, 1934.

37. Simon, E.: Efficiency of Antroscopic Examination of the Maxillary Sinus, Ann. Otol., Rhin. & Laryng. **43**:813 (Sept.) 1934.

canal averaging 6 mm. in length. He describes more than one type of ostium, such as duplicate ostia, joined normal canals, accessory ostia, duplicate accessory ostia and joining accessory canals.

Ridpath [38] stresses the frequency with which persisting symptoms about the head are due to disease of the sphenoid sinuses in the absence of usual empyema or purulent discharge and has obtained excellent results from opening the sinus. He emphasizes the need for careful examination, including cocainization and the use of the nasopharyngoscope and the probe. He has seldom seen a case of acute sphenoiditis; more often there is an acute exacerbation of a chronic condition. Reflex pains in the mastoid and muscles of the neck radiating to the clavicular region are due to involvement of the sympathetic nerves. Among other symptoms mentioned are pain in the cuspid tooth of the same side and burning or stabbing pain at the junction of the soft palate and anterior pillar. A new symptom observed by the author is pain, dull and continuous, over the pyriform crest. Vertigo may be present, which is increased on rapid change of the position of the head. Sleeplessness, malaise, periodic postnasal discharge and spasmodic tickling cough have also been noted. The objective findings by means of the nasopharyngoscope are congested, swollen mucosa in the spheno-ethmoid recess and possibly discharge in the olfactory fissure. In cases in which the condition is chronic there may be a thick secretion, scabbing and odor, enlargement of the blindspot and, occasionally, paresis of the extraocular muscles. The author mentioned a whole array of subjective symptoms that may be present with the chronic condition, including pressure, mental, ocular, toxic, olfactory and general systemic symptoms. The importance of first suspecting and then carefully examining the sphenoid sinuses in such cases cannot be overemphasized.

Hays,[39] on the other hand, calls attention to cases in which the symptoms suggested involvement of the sinus but which were in fact due to other conditions. Several cases of intense pain in the head and over the eyes in which the sinuses were suspected proved to be caused by intestinal intoxication; relief followed thorough evacuation and intestinal antisepsis. The author cautions against too early assumption that radical operation is indicated. He cites 1 case in which meningitis followed a radical operation on the frontal sinuses which was performed on the basis of severe pains in the head and a roentgenogram showing cloudy frontal sinuses with indefinite margins. The patient, as a matter of fact, had no frontal sinuses; the surgeon undoubtedly penetrated to the brain, thinking that he was entering the sinus through its anterior plate. Severe pains in the head alone are not sufficient indi-

38. Ridpath, R. F.: The Sphenoid Sinus, Laryngoscope **44**:657 (Aug.) 1934.

39. Hays, H.: Pseudo-Sinus Conditions, M. Rec. **139**:633 (June 20) 1934.

cation for hurried surgical intervention. Certainly other sources of toxemia should be investigated and ruled out.

Headaches of various types are fully discussed by Fox.[40] He describes the characteristic headache in each form of sinusitis and attempts to differentiate them from headache due to other causes.

THE SINUSES AND OCULAR APPARATUS

As stated in the introduction, retrobulbar neuritis has been the topic of considerable discussion in the foreign literature. Weill and Nordmann [41] cite 2 cases which illustrate the uncertainties attending the diagnosis and treatment of this lesion. In 1 case, that of a man of 31 with gradual loss of vision, pains in the eye, central scotoma and loss of color vision whose fundus was normal, a diagnosis of spheno-ethmoid suppuration was made and the sinuses were operated on. Vision returned. Three years later the patient was seen again with vertigo and other vestibular symptoms. Vision was normal except for loss of color vision in one eye. Both fundi were normal. Neurologic examination revealed definite manifestations of multiple sclerosis. In the other case, the patient, a man of 60 who had always had good vision, began noticing a decline of visual acuity in the right eye in 1917. There was a large central scotoma, partial for white and total for blue. He could not distinguish green or red. A general examination yielded negative results. Rhinologic examination disclosed suppurative ethmoiditis on the right. Operation was not followed by improvement in vision, which gradually failed completely although the general condition was excellent for nearly a year. At that time the patient's gait became slightly unsteady and gradually grew worse. Since 1930 walking had been impossible. Neurologic examination revealed multiple sclerosis due to bilateral involvement of the pyramidal tract plus an intention tremor.

Such cases as these leave the authors in doubt, first, as to whether the sinuses are the real portal of infection, second, as to whether the condition in such cases is helped by operation, and, third, as to whether the results would not be the same without operation. It would be interesting if surgeons would reexamine their patients previously operated on for signs of sclerosis and compare their statistics with those for patients in whom the condition exists but who are not operated on. The authors are not convinced that operation can in any way prevent the occurrence of sclerosis, although they admit that it may clear up optic neuritis.

---

40. Fox, C. C.: Sinus Headache Different from Headaches of Other Origin, Arch. Otolaryng. **20**:813 (Dec.) 1934.

41. Weill, G., and Nordmann, J.: Névrite retrobulbaire-sinusite-sclérose en placques, Rev. d'oto-neuro-opht. **12**:496 (July) 1934.

Terracol [42] reviews the question of retrobulbar neuritis from every possible angle. The etiology is frequently obscure; in 50 per cent of cases it is never definitely determined. Whether the disease tends to heal spontaneously or whether it is always the precursor of multiple sclerosis is another question he cannot answer. Every patient with retrobulbar neuritis should have a thorough rhinologic examination. Terracol is convinced that it is not the frankly suppurative cases that cause trouble as much as the simple hyperemic toxic cases. He compares the situation to facial paralysis *à frigure* occurring in conjunction with catarrhal otitis media. In acute cases, especially with bilateral rapid loss of vision, the author advises prompt release of the pressure on the optic nerves. Both the ethmoid and the sphenoid sinuses must be opened. In the milder cases one may obtain good results by the following procedure: thorough cocainization of the upper meatuses and anterior wall of the sphenoid sinus, irrigation of the sphenoid sinus, dilatation of its ostium and the application of a solution of phenol to the mucosa of the sinus. He believes that the marked vasomotor reaction resulting has a beneficial effect on the vascular and nutrient apparatus of the optic nerve. The oculist should follow the case closely, and should there fail to be any improvement operation on the sinuses must no longer be delayed.

In answer to the question as to why there are not more cases of retrobulbar neuritis associated with frankly purulent sphenoiditis, Terracol explains: First, the anatomy varies in different persons; second, it is a question of the organism involved and its toxins, and, third, the presence of pus usually indicates good local resistance to infection.

Guyonnet-Duperatt [43] disposes of the question by advising thorough evisceration of the sphenoid and ethmoid sinuses, even in cases in which clinical signs of sinusitis are wanting.

Bailliart and his associates [44] report a case of bilateral retrobulbar neuritis of one month's duration with central scotomas. Both sphenoid sinuses were opened by the transeptal route, as described by Hirsch. Definite improvement in vision followed within a few days, although optic atrophy was diagnosed by ophthalmoscopic examination. During convalescence the authors studied the blindspot and the shadows of the blood vessels by perimetry. They determined by tonoscopic examination that there was a lessening of intra-ocular pressure. They recom-

42. Terracol, M.: Le traitement d'urgence de la névrite optique rétro-bulbaire aiguë d'origine sinusienne: La phénolisation, Rev. d'oto-neuro-opht. **12**:401 (June) 1934.

43. Guyonnet-Duperatt: Névrite optique rétro-bulbaire: traitée chirurgicalement, Rev. de laryng. **55**:526, 1934.

44. Bailliart, Baldenweck and Tillé, H.: Névrite rétrobulbaire traitée par l'operation de Segura Hirsch, Bull. Soc. d'ophth. de Paris, 1934, p. 22.

mend that every case be studied by angioscotometry, photography of the fundus and the Bailliart tonoscope. The authors express the opinion that operation improves the vascular tone, relieving vasomotor tension, and has much to do with promoting a cure.

Sabbadini and Silvagni[45] report 3 cases of retrobulbar neuritis apparently with origin in the sphenoid sinuses in 2 of which operation on the sphenoid and ethmoid sinuses yielded prompt relief, while in the third the patient was slower in recovering. The authors call attention to the so-called dissociation between the findings in the fundus and the status of the visual fields following operation. A clinical cure does not always imply improvement of the picture in the fundus. In 1 case of pallor of the temporal portion of the disk and in another of pallor of the total disk no change was evident despite restoration of the visual fields. The authors express the opinion that persistence of pallor of the disks is due not so much to atrophy of the nerve as to circulatory disturbance, viz., an angiospasm of the vasa nervorum.

An interesting case of extensive tertiary syphilis of the sphenoid sinuses causing blindness is described by Bonnet and his associates.[46] The patient, a man aged 38, acquired syphilis about fourteen years before examination. For the past three years he had suffered yearly attacks of frontal sinusitis. His vision was normal up to a few days before examination, when, within a period of twenty-four hours, he went blind in both eyes. Examination revealed bilateral optic atrophy with pallor of both disks. Vision was nil. There was extreme atrophy in both nasal chambers. The septum was gone, and there was erosion of both sphenoid sinuses with loss of the posterior wall on the right side. Later, sequestration of large masses of the sphenoid process took place. The diagnosis was gumma of the basilar process with secondary abscess causing pressure on the chiasm. The blindness was permanent.

Closed empyema of the posterior ethmoid sinus was responsible for blindness in a case reported by Cerise and his associates.[47] The patient, a man of 38, had increasing to total blindness in the left eye over a period of eight days. There were periorbital and retro-orbital pains and headache. The left fundus was cloudy and slightly edematous, and there was an extensive central scotoma. Rhinologic and roentgen examinations yielded negative results. The septum was resected, the

45. Sabbadini, D., and Silvagni, M.: Rilievi sulle neuriti ottiche retrobulbari sinusogene operate, Riv. oto-neuro-oftal. **11**:81, 1934.

46. Bonnet, P., Sargnon and Paufique, L.: Specificité avec signes d'ozène nasal: Sinusite sphénoïdale bilatérale avec cécité complète; Séquestres du sphénoïde, Lyon méd. **153**:275 (March 4) 1934.

47. Cerise, L.; Ramadier, J., and Guillon, H.: Cécité unilatérale: Empyeme clos latent d'une cellule ethmoïdale postérieure. ouverture chirurgicale: guérison, Rev. d'oto-neuro-opht. **12**:499, 1934.

middle turbinate was removed, and the posterior ethmoid cells were opened. There was an escape of 2 cc. of fetid pus. The headache disappeared, and vision returned to normal in two weeks. Recovery was complete.

Venco [48] reports 3 cases of acute bilateral optic neuritis in which the etiology was obscure. Careful and thorough examination of the sinuses gave negative results. Because of the rapid progress of the disease with loss of vision and atrophy and despite the absence of clinical or roentgenologic signs of sinusitis, the sphenoid sinuses were opened. No pathologic process was found, yet the vision improved immediately. The improvement was slow, however, which the author attributes to the fact that surgical intervention had been delayed and atrophy of some of the optic nerves had already ensued. The author states that the clinical manifestations of rhinogenic optic neuritis are very diversified, which complicates the diagnosis. He stresses the following points: First, in all cases involvement is bilateral; second, the visual fields are different, and, third, the end-result is always optic atrophy unless the process is halted.

Optic neuritis was produced experimentally by Gritti,[49] who opened the frontal sinus on one side in four dogs, infected the sinus with a virulent streptococcus of typhus and then closed the wounds tightly. After two months the dogs were killed and sections were made. The sinuses were full of pus and the overlying dura was very much infected. Histologic examination of the optic nerves revealed positive findings in two of the dogs, i. e., round cell infiltration of the nerve sheath and between the nerve fibers extending upward to the cribrum, with dilatation of the vessels and perivascular infiltration. Gritti believes that these results controvert the statement of many that retrobulbar neuritis is always due to multiple sclerosis.

Stauffer [50] cites a number of cases illustrating various forms of orbital and optic disease the result of infection of the sinus. The following is impressive:

1. Blurred vision, with diplopia of high degree for ten years, due to chronic pansinusitis; cured by the Caldwell-Luc operation and external operations on the frontal sinuses.

2. Epiphora, due to chronic maxillary sinusitis; Caldwell-Luc technic at operation with complete recovery in two weeks.

---

48. Venco, L.: Considerazioni tratte dall'esame di tre casi di atrofia del nervo ottico di origine rino-sinusale, Boll. d'ocul. **13**:267 (Feb.) 1934.

49. Gritti, P.: Neurite ottica retrobulbare da sinusite frontale (richerche sperimentali), Riv. oto-neuro-oftal. **11**:129, 1934.

50. Stauffer, N. F.: Eye Diseases Caused by Sinusitis, Laryngoscope **44**:190 (March) 1934.

3. False objects (black objects seen on the right), with headache, due to pansinusitis; external operations on the frontal and ethmoid sinuses and Caldwell-Luc operation performed; rapid recovery, although double vision ensued three weeks later.

4. Pain and blurred vision, due to chronic frontal sinusitis; external operation performed, followed by diplopia for one year which then disappeared; all pains relieved.

5. Acute conjunctivitis of sudden onset with red eyes and lacrimation; pus found under the middle turbinate; cure obtained through intranasal treatment.

6. Choroiditis with chronic infection of the ethmoid sinus complicated by a high deviation of the septum; operation refused.

7. Subacute swelling of lids, due to frontal and maxillary sinusitis; modified Killian and Caldwell-Luc operations performed, with cure.

8. Headaches and double vision, due to chronic frontal sinusitis; operation followed by partial relief; subsequent more radical operation led to cure.

9. Itching eyes, swollen lids and headache following six weeks' cold, with profuse nasal discharge; cloudy frontal and maxillary sinuses; modified Killian and Caldwell-Luc operations; cellulitis of the orbit; cure.

In several other cases edema and swelling of the lids and forehead due to acute sinusitis were cured by simple incision and external drainage.

Corrado [51] reports a case of severe orbital cellulitis in a man about 77. There were marked edema and redness of the lids and the surrounding skin. A fistula was present at the lower margin of the orbital border from which yellowish-green pus was discharging. There were chemosis and exophthalmos, the bulb being pushed forward, outward and downward. A roentgenogram showed involvement of the posterior ethmoid and frontal sinuses. The pupil was dilated and only perception of light remained. When the acute symptoms subsided the optic nerve was completely atrophied, vision was nil and there was partial ectropion of the lower lid.

Cordero [52] examined 78 patients with dacryocystitis rhinoscopically, roentgenologically and by transillumination and found disease of the sinuses present in 79 per cent. In 46 per cent of the cases the diagnosis was positive and in 33 per cent extremely likely. Disease of the sinuses

51. Corrado, A.: Su di un caso di etmoidite posteriore con complicanze orbitarie e fistole cutanee, Rassegna ital. d'ottal. **3**:436, 1934.

52. Cordero, C.: Rapporti tra dacriocistiti ed affezioni sinusali, Riv. otoneuro-oftal. **11**:60, 1934.

is common in the acute cases. The ethmoid sinuses were most frequently involved, singly in 22 per cent of cases and in combination with other sinuses in 51 per cent. The history in most instances disclosed the occurrence of disease of the sinuses either coincidental with or subsequent to the dacryocystitis. The treatment was usually surgical.

Wilkinson [53] advocates radical operation on the ethmoid and sphenoid sinuses in all cases in which these sinuses are the focus of infection for such diseases as corneal ulcer, chronic iritis, uveitis, opacities of the vitreous, episcleritis, choroiditis, retinitis, ocular hemorrhage and optic neuritis. He cites the technic described by Sewall, Smith and others, and claims that the operation is without danger and easily performed.

THE SINUSES IN RELATION TO DISEASES OF OTHER ORGANS

Pulmonary Diseases.—Clerf [54] observed 200 cases of bronchiectasis and found concurrent infection of the sinuses in 82.4 per cent. This applies particularly to cases of bilateral bronchiectasis, the sinuses seldom being thus affected in cases of unilateral involvement. Clerf believes that the infection is carried by aspiration or by way of the lymphatics. Roentgenograms show a shadow at the hilus and widening of the bronchial spurs due to enlargement of the peritracheal and bronchial glands. As a rule, an acute intercurrent infection is necessary to start the bronchiectasis when superimposed on a predisposing infection of the sinuses. In children acute bronchitis, bronchopneumonia and lobar pneumonia are all really acute pneumonitis of brief clinical course and associated with damage to the bronchial mucosa. The presence of spirochetes or streptococci makes the onset of bronchiectasis more certain. Every unexplained cough of long duration should lead to thorough examination of the sinuses. The prognosis of bilateral bronchiectasis is unfavorable. Even cure of the sinusitis will often fail to influence the pulmonary condition. Clerf lays particular stress on prophylaxis. Every case of acute bronchitis may be the start of bronchiectasis, and the disease can often be cut short by attention to existing sinusitis. Bilateral bronchiectasis associated with infection of the sinuses may be ameliorated by drainage of the sinus, postural drainage, aspiration vaccines and the like. The results are better in children than in adults if treatment is persisted in. The author does not recommend surgical intervention in such cases in children.

---

53. Wilkinson, O.: Importance of Radical Ethmoid and Sphenoid Operation in Relief of General and Ocular Diseases, Ann. Otol., Rhin. & Laryng. **43**:1120, (Dec.) 1934.

54. Clerf, L. H.: The Interrelationship of Sinus Disease and Bronchiectasis with Especial Reference to Prognosis, Laryngoscope **44**:568 (July) 1934.

Spence [55] also believes that infection is carried from the sinuses to the peribronchial glands by way of the lymphatics. He mentions as well the possibility of direct aspiration or extension along the swollen mucosa. The offending sinus may be the seat of either a suppurative or a hyperplastic process. He cites 2 cases in young adults with symptoms resembling tuberculosis: loss of weight, cough and elevated temperature. Roentgen observations were confined to the hilus and lower lobes. Ethmomaxillary infection was found in both instances, and operation led to prompt clearing up of the pulmonary symptoms with gradual restoration to normal health.

Persky [56] points to the frequency with which sinusitis in children causes cough. The treatment must be constitutional as well as local: Diet, cod liver oil, tonics for the blood and vaccines are in order. He cautions against the use of silver compounds if a quartz mercury vapor lamp is employed. Locally he advises removal of tonsils and adenoids, suction, the instillation of ephedrine and other measures to establish drainage.

A case in point is cited by Kerley.[57] A 4 year old boy suffered from persistent cough over a period of three months, which was worse at night. Roentgenograms showed cloudy antrums. The treatment consisted of tampons of a 5 per cent solution of mild silver protein applied weekly for ten minutes, followed by irrigation with saline solution. Recovery took place with relief from the cough in a period of three weeks.

Dean [58] states that many children with bronchiectasis give a history of repeated colds and nasopharyngeal infections over a period of from two to three years. Often allergy is present and it is difficult to tell which was first, the infection or the allergy. From the standpoint of therapy this is not so important. It is usually best to treat the allergic factor first. In discussing the diagnosis he mentions the fact that eosinophilia does not always imply allergy. It may be due to digitalis, trauma or parasites. On the other hand, the absence of eosinophilia does not exclude the possibility of allergy. Polymorphonuclear leukocytes, if consistently present, certainly indicate infection. Bacteriologic examination of secretions is important. He cautions against too much reliance

55. Spence, E. L.: The Relationship of Chest to Sinus Diseases, Ann. Otol., Rhin. & Laryng. **43**:579 (June) 1934.

56. Persky, A. H.: Sinusitis in Children: A Practical Consideration of Its Treatment, Arch. Pediat. **51**:589 (Sept.) 1934.

57. Kerley, A. H.: Persistent Cough and Sinus Involvement, Arch. Pediat. **51**:470 (July) 1934.

58. Dean, L. W.: Relationship Between Diseases of the Nose and Throat and Pulmonary Diseases, J. Missouri M. A. **31**:13 (Jan.) 1934.

on roentgen findings in a diagnosis of infection, as clouding may be due to allergic swelling of the mucosa or may be the result of nephritis. The nasal examination is important. Pale mucosa and absence of glandular irritation usually mean allergy; red mucosa and swollen glands, infection. Patients with bronchiectasis and chronic bronchitis are benefited by the removal of tonsils and adenoids and proper attention to the sinuses.

Wasson and Waltz [59] studied 100 children by roentgenograms taken every three months from birth to the age of 10. Also, each child was given the usual clinical and laboratory tests. The authors found a definite relationship between disease of the sinuses and nontuberculous diseases of the chest, and they suggest the term bronchosinusitis for such combinations of conditions. They believe that the onset in both regions is simultaneous and the progress parallel. Increased severity in one means equal severity in the other. Cessation of the infection of the sinuses is usually followed by clearing of the condition in the chest. The characteristic findings in the chest are a bilateral increase in the width of the hilus and accentuation of the perivascular and peribronchial markings. Only in cases in the advanced stage were changes in the connective tissue noted in the parenchyma. In all these cases the sinuses had definitely hazy outlines and cloudy interior. The authors cite a number of typical cases and include numerous interesting roentgenograms of successive stages in the process.

Campbell [60] studied sinusitis in relationship to pneumonia. He found sinusitis present in 100 per cent of 130 patients with bronchopneumonia and lobar pneumonia. The diagnosis in all but 10 cases was made by examination with the nasopharyngoscope. The ethmoid sinuses were more commonly involved in young children, while in infants all the sinuses were likely to be affected. Acute otitis media developed in all but 18 cases. The author attributes the frequency of acute pulmonary infections complicating sinusitis in young children to the fact that nasal secretions are aspirated instead of being expelled. The ability to clear the nasal passages should decrease the incidence in older persons.

Sippe [61] has contributed an interesting article on hypoglycemia and ketosis as a basis for persisting infection of the antrums and bronchiectasis. Ketonuria is evidence of a deficiency of dextrose available for complete combustion of fats. Patients with such a condition pos-

59. Wasson, W. W., and Waltz, H. D.: Relationship of Sinus Disease to Chest Disease in Children, Radiology **22**:432 (April) 1934.

60. Campbell, E.: Incidence and Significance of Sinusitis in Pneumonia, Arch. Otolaryng. **20**:696 (Nov.) 1934.

61. Sippe, C.: Hypoglycemia and Ketosis: Their Relationship to Chronic Antral Disease and Bronchiectasis, M. J. Australia **1**:675 (May 26) 1934.

sess what Lapage has termed an exudative diathesis, and the condition is considered closely linked with the allergic state. Sippe cites several cases in both adults and children of chronic disease of the antrums, asthma or bronchiectasis in which acetonuria and a low blood sugar content were noted. The administration of dextrose and an antiketonic diet yielded prompt relief. In 1 case a woman of 36 with asthma had gone through several operations on her sinuses without relief. Roentgenograms of the chest showed extensive fibrosis. A dextrose-tolerance test revealed the following values (in percentage):

Fasting	½ hour	1 hour	1½ hours	2 hours
0.062	0.093	0.123	0.093	0.093

Administration of dextrose completely eliminated the attacks.

In a discussion of the relationship of sinusitis to asthma Connor [62] expresses the opinion that it is important to recognize and evaluate the allergic and infectious elements in nasal hyperplasia. He states that one should never operate on a patient with asthma until every effort has been made to eliminate or control the allergic factors. Operative treatment in the nonsuppurative cases will give relief for a time, but the results are not lasting. Certainly his personal experience has not been as satisfactory as that of others who have reported glowing results. As for the cases in which there is suppuration, Connor is in favor of surgical intervention and believes that the results justify the procedure.

Settle [63] reviews much of what has been said regarding the connection between maxillary sinusitis, chronic cough and bronchiectasis. He considers bacterial invasion to be the original cause of sensitization to protein with allergic symptoms appearing later. He also discusses sinusitis as a possible etiologic factor in certain cases of mental disorder, optic neuritis and cardiac disease.

Rouglin [64] reports several cases which illustrate the arguments set forth in the previous paragraph. A child of 7½ years following an attack of influenza had mild asthma and bronchitis which lasted about a year. Bilateral infection of the ethmoid sinuses and of the antrum was diagnosed. Treatment by posture, suction and instillations brought about a cure in ten weeks. Mental depression, malaise and bronchitis in a man of 47 yielded to surgical treatment of a deviated septum and maxillary sinusitis. In several other cases depression, loss of weight and malaise were traced to chronic sinusitis with recovery following operation.

---

62. Connor, C. E.: Sinusitis and Asthma, Minnesota Med. **17**:582 (Oct.) 1934.

63. Settle, N.: Systemic Complications in Sinusitis, Laryngoscope **44**:398 (May) 1934.

64. Rouglin, L. C.: Nasal Accessory Sinus as Foci of Infection, J. M. A. Georgia **23**:422 (Nov.) 1934.

Diseases of the Central Nervous System.—Graves [65] cites 2 cases to illustrate the results of therapy of the sphenoid sinuses in cases of mental disorder. A woman, aged 25, with a history of headache, cacosmia, nervous breakdown, depression, asthenia and malaise for two years was admitted to the hospital with acute mania, confusion, cardiovascular instability and asthenia. Sedatives were of no avail. Pus was found in the nose and the crypts of the tonsils. Antiscarlet fever serum was given. Pus was again found and was traced to the sphenoid sinuses and the antrum, which were drained intranasally. Nonspecific protein therapy was given, but the patient was still maniacal. The tonsils were then removed, and a preparation of colloidal sulphur was given intramuscularly. Improvement began, and recovery soon followed. There was no recurrence of symptoms in more than a year.

Another patient, a woman aged 41, five years previously, after her sixth pregnancy, became obese. She had a huge appetite, and there were an enlarged thyroid, vertigo, cyanosis, periods of confusion and of anger alternating with somnolence, reduced visual acuity and severe headache. The sugar content of the blood suggested a pituitary disorder. Injections of a solution of pituitary had no effect. Roentgenograms gave no evidence of tumor; the Wassermann reaction was negative. There was evidence of disease of the sinuses on examination. Lumbar puncture yielded negative results. Both the sphenoid sinuses and the antrums were drained, and improvement followed. The tonsils were removed, and improvement continued. The patient went home with the mental disturbance entirely cleared up and had remained well for almost a year, up to the time of writing.

James [66] describes a case of idiopathic epilepsy which developed rather suddenly six months previous to examination in a man of 30. The attacks, which appeared weekly in the beginning, increased in frequency. The patient complained of a sensation of pressure over the eye. A general examination yielded negative results. The attacks were preceded by the impression of a bright light before the eyes and stiffness of the neck and facial muscles followed by unconsciousness. No particular group of muscles was involved. The attack would be general, lasting about five minutes and followed by headache. Nasal examination revealed a deviated septum, an edematous lateral wall on the left and a dark left antrum on transillumination. Roentgenograms showed a tumor in the antrum. An operation by the

65. Graves, T. C.: Sphenoidal Sinus Disease in Mental Disorder, Proc. Roy. Soc. Med. **27**:1515 (Sept.) 1934.

66. James, J. E.: Mucoid Cyst of the Maxillary Sinus Causing Epilepsy, Pennsylvania M. J. **37**:1007 (Sept.) 1934.

Caldwell-Luc technic disclosed a cyst the size of a small hen's egg with several smaller cysts. The entire contents of the antrum were removed. The diagnosis was mucous cyst. During the eight years that have followed there has been no recurrence of symptoms.

Arthritis.—Snyder and his associates [67] examined 386 patients with arthritis of more than six months' duration by stereoscopic roentgenography of the sinuses. In 262 cases (68 per cent) they found evidence of varying degrees of sinusitis with no relationship between the degree of involvement of the sinuses and the severity of the arthritis. In 77 cases the sinusitis was of the silent or asymptomatic type. Marked clinical improvement occurred in all cases in which treatment was given. The methods of treatment were varied and are not discussed. Histories of 7 cases of the typical silent type are reported.

Cardiovascular Disease.—Kistner [68] made bacteriologic studies from fresh tissue removed from over 400 patients with chronic nonsuppurative sinusitis and found a predominant growth of streptococci in over 80 per cent of the specimens. The most consistent finding was that of a diplococcus having staining qualities of streptococci and located in the deeper layers of the mucosa and in the thickened walls of blood vessels. He further studied tissue removed from the sinuses of 18 patients with cardiovascular disease, and in 11 specimens there were organisms in the thickened walls of the vessels and infiltration of cells characteristic of chronic inflammation. Following the deaths of 12 persons from cardiovascular disease Kistner sectioned and stained the coronary vessels and examined them for bacteria. Ten sections showed fresh thrombi and 2 old thrombi. There were bacteria in numerous areas of infiltration. In support of his theory of infection as a factor in the production of vascular disease the author offers the following conclusions and evidence:

1. Experimental production of vascular disease by inoculations of pathogenic bacteria.

2. Presumptive clinical evidence that acute infection may produce vascular disease.

3. Histologic evidence of vascular changes being the outstanding incident in the tissues of infected sinuses.

4. Presence of morphologically identical organisms in the walls of the sinuses and the heart.

---

67. Snyder, R. G.; Fineman, S., and Traeger, C.: Importance of Roentgenologic Examination of the Sinuses in Chronic Arthritis, with Special Reference to Cases in Which the Sinuses Are a Silent Focus of Infection, Arch. Otolaryng. **19**:23 (Jan.) 1934.

68. Kistner, F. B.: Nasal Sinus Infection Associated with Diseases of the Vascular System, Ann. Otol., Rhin. & Laryng. **43**:89 (March) 1934.

Gastric Diseases.—Karpowa and his associates [69] found a definite connection between infections of the antrum and gastric acidity. In cases of hypo-acidity operation on the antrum was followed by an increase in the acid content of the stomach and in the fermentative power of the gastric juice. In cases of achlorhydria clearing up of the infection of the antrum restored gastric acidity. Achylia gastrica, however, was not benefited by the operation. In cases of hyperacidity operation was followed by a reduction in the acidity to approximately normal. In normal persons it was found that there was a tendency for acidity to increase after the operation, but it dropped back to normal within a short time.

Diseases of the Middle Ear.—Cullom [70] cites four different types of investigations including his own showing that there is an incidence of from 85 to 95 per cent of involvement of the sinuses present in infections of the middle ear. He quotes Childs, who studied 383 cases of scarlet fever and found that involvement of the sinus was diagnosed by roentgen examination in 91 per cent. Fowler studied deafness in children and found associated disease of the sinus in 91 per cent. Campbell found disease of the sinuses in 90 per cent of 150 children with infections of the ear. Cullom's 100 cases occurred mostly in adults. He believes that the ears are infected by pus draining backward over the eustachian orifice. He mentions the immunity of animals to infections of the sinuses because the natural opening is near the dependent portion and thus favors drainage. When man assumed the upright position his antral orifice was placed near the top of the sinus, thus making drainage by gravity impossible. Richards, in discussing the paper, cited statistics from the Massachusetts Eye and Ear Infirmary. In 100 cases of acute mastoiditis there was involvement of the sinuses on the same side in 15 per cent, on the opposite side in 12 per cent and on both sides in 41 per cent. In 32 per cent of the cases neither side was affected. He believes the large percentage of bilateral involvement is concomitant rather than casual. The general discussion brought out some differences of opinion as to whether the relationship between sinusitis and infections of the ear is causal or merely coincidental. It was the consensus, however, that early attention to symptoms in the sinuses may influence or prevent concurrent or subsequent infection of the ears.

---

69. Karpowa, R., et al.: Ueber Beziehung der Erkrankungen der Nasennebenhöhlen zu der sekretoren Magentätigkeit, abstr., Zentralbl. f. Hals-, Nasen- u. Ohrenh. **23**:494 (Nov. 10) 1934.

70. Cullom, M. M.: The Association of Sinus Disease and Middle Ear Infection, J. A. M. A. **103**:1695 (Dec. 1) 1934.

SINUSITIS IN CHILDREN

Kerley and Lorenze [71] studied a series of 670 infants and children and found roentgen evidence of disease of the sinus in 452. In the vast majority involvement occurred in the maxillary and ethmoid sinuses. Three hundred and eleven of these patients had previously had their tonsils and adenoids removed. The authors point to the significance of this fact as demonstrating the ineffectiveness of tonsillectomy in preventing disease of the sinuses. The chief complaints on admission to the hospital were frequent colds, persistent cough, asthma, nasal discharge, elevated temperature and rheumatism. Among the remaining 195 in the entire group investigated, 34 were normal children used as controls and 23 were newly born. In 161 who had symptoms that might have been due to sinusitis, but failed to show roentgenographic evidence of it, further examination revealed that the etiology bore no relation to the accessory sinuses. In this group the ailments were colds, muscular rheumatism, cough, asthma, nasal discharge and elevated temperature. In cases of involvement of the sinuses in which the patients were under treatment the condition was checked by roentgen examination at two to four week intervals.

In the management of these cases the authors lay stress on proper diet. They believe that American children eat too much sugar. For profuse nasal discharge they advise atropine in nearly physiologic doses. They also recommend that the patient sleep without a pillow. In only 3 cases was surgical intervention required. In 7 cases the Eggston polyvalent vaccines were used. The local treatment consisted of tampons of a 5 per cent solution of mild silver protein for fifteen minutes at from five to seven day intervals and douches of saline solution morning and evening. The authors do not recommend silver salts for home use.

Ashley [72] reviews the history and generally known facts about symptoms, etiology and treatment of sinusitis in children. In his summary he presents the following statements:

1. The predisposing factors are anatomic malformations, allergy, glandular dysfunction and poor hygiene.

2. The existing causes are acute infections of the upper respiratory tract, acute exanthems, swimming, diving and contact with other infected persons.

3. The local as well as the general symptoms are manifold.

---

71. Kerley, C. G., and Lorenze, E. J., Jr.: A Study of the Sinuses and Sinusitis in Infants and Children, M. Rec. **139**:213, 1934.

72. Ashley, R.: Sinus Disease in Children, California & West. Med. **40**:156 (March) 1934.

4. Diagnosis depends on the proper evaluation of the symptoms. Two cardinal signs are postcervical lymphadenitis and lateral pharyngitis. The roentgen findings are important.

5. Treatment consists in the local application of hygroscopic solutions of colloidal silver in nasal packs, in general measures according to the indications and in conservative surgical procedure.

Dean [73] gives a long list of diseases that may be associated with infection of the sinuses. He makes a plea for careful study of the sinuses in all cases of cardiac disease and arthritis in which treatment of the lymphoid tissues of the throat is required. He finds roentgenograms useful only in determination of the size and location of the sinuses. Shadows are too frequently due to allergy or nephritis. The radical operation on the antrums is not indicated in children unless there is bony necrosis. In not more than 1 in 100 cases of involvement of the sinuses is surgical intervention required. Operation is indicated if osteomyelitis is present or severe constitutional disease fails to yield to conservative treatment. He places chief reliance on the removal of obstruction to ventilation and drainage.

Mithoefer [74] believes that disease of the sinuses in children starts in the nasopharynx, spreading from there to the nasal cavities and then to the sinuses. In infants the posterior choanae are high and small, forming a recess behind the nose which favors retention. This retention of secretion is further encouraged by the presence of adenoids. In some cases constitutional dyscrasias account for predisposition to disease of the sinuses, allergy being an example of this type. Unfortunately tests for cutaneous sensitization are less satisfactory in children than in adults, according to the author. Hyperplasia resulting from attacks of acute infection may defeat desensitization, and relief can be had only after the infection is cleared up. The author recommends surgical intervention in such cases, contrary to the advice of other authors cited in this section.

Mithoefer's treatment for acute sinusitis is as follows: rest in bed and then administration of acetylsalicylic acid, injections of nonspecific protein intramuscularly daily for five days and alkalis. Locally he advises instillations of a mixture of the zinc salt of di-iodo-para-phenolsulphonic acid, 0.05 per cent, procaine hydrochloride, 0.1 per cent, epinephrine chloride (1 : 3,000), 3 per cent, and distilled water, 10 per cent. Five drops of this mixture should be instilled in the nose three times daily. In chronic cases the author stresses the importance of combating

73. Dean, L. W.: Nasal Sinus Disease in Children, South. M. J. **27**:418 (May) 1934.

74. Mithoefer, W.: A Practical Consideration of the Nasal Accessory Sinuses in Children, Laryngoscope **44**:789 (Oct.) 1934.

dyscrasias. Symptoms such as constipation, slow pulse, subnormal temperature, dry skin, asthenia, cold hands and feet, enuresis and frequent colds indicate hypothyroidism, and the patient requires thyroid extract. The dose is controlled by carefully watching the daily temperature and weight. A diet high in vitamins and calcium gluconate are also helpful. Locally, suction and irrigation are recommended. In some cases surgical intervention is required. The author advises opening the antrum through the middle rather than through the inferior meatus. In cases in which the condition is associated with large bronchial glands roentgen therapy is beneficial, with ¼ erythema dose, repeated in eight weeks if necessary.

The pathology of sinusitis in children does not differ from that in adults, according to Spielberg.[75] The involvement is less extensive, being most frequently located in only one or two sinuses. Atrophic changes are seen early in children, frequently without preceding hypertrophy. Numerous histologic descriptions are included in the article.

From Leegard's clinic in Oslo, Thorkildsen [76] reports a study of sinusitis in a group of 204 children. There were 124 with symptoms of nasal obstruction and rhinitis. Chronic infection of the maxillary and ethmoid sinuses was diagnosed in 16. The diagnosis was made by roentgen examination or by puncture. The symptoms were discharge, slight odor, headache and occasional low fever. Sedimentation of the blood and determination of bacterial flora seemed to indicate that the sinusitis was not a true bacterial infection but rather that retained mucus offered a favorable culture medium for germs of low pathogenicity which are capable of keeping up an inflammatory state. The treatment followed was lavage, vaccine and general hygienic therapy. Aside from the removal of adenoids, surgical intervention was rarely indicated.

Kharina-Marinucci [77] reports a case of acute sphenoiditis in a child of 18 months. On the fifth day of an acute attack of nasopharyngeal catarrh a definite Brudzinski sign developed. Other symptoms of meningitis were lacking according to the author, because of the small size of the sphenoid sinuses which afforded but little contact with the sella turcica. Examination of the spinal fluid yielded negative findings. Examination of the nose disclosed acute rhinitis, swollen adenoids and postnasal discharge. Recovery ensued in fifteen days. The author recalls a similar case in a child of 4 years in whom opisthotonos, strabismus and exophthalmos were present. He refers to Langstein on

75. Spielberg, W.: Pathology of Chronic Sinusitis in Children, Laryngoscope **44**:885 (Nov.) 1934.

76. Thorkildsen, V.: Sinus in Children of Seven to Twelve Years, Acta otolaryng. **20**:516, 1934.

77. Kharina-Marinucci: Un caso di sfenoidite acuta in un bambino di 18 mesi, Soc. ital. pediat. **3**:318, 1934.

diagnostic errors in cases of meningitis in infants with marked nasopharyngitis in whom stiffness of the neck and bulging fontanels were the predominating symptoms. The author explains the retracted neck as being due to an involuntary effort to get more air. As for the tense fontanels, he offers this solution: The cranial base being incompletely ossified, intracranial pressure may be easily produced by extracranial causes. Onodi's Anatomy of the Nasal Cavity and Its Accessory Sinuses" shows dehiscences up to 5 by 6 mm. Principal ossification begins in the third to fourth year and may not be complete until puberty.

Sargnon and Euvrard [78] report ten cases of severe acute sinusitis in children, emphasizing the importance of early diagnosis. In a discussion of the embryology of the fronto-ethmosphenoid system they point out the following facts: The anterior ethmoid sinuses are present much earlier than the posterior sinuses. The latter as well as the sphenoid sinus are seldom developed before the age of 5 years. The frontal sinus is absent in the fetus and is infrequently found before the age of 5. Clinically, therefore, one should find acute ethmoiditis of the anterior group before the age of 6, while involvement of the frontal and sphenoid sinuses is extremely rare before the age of 14. Under etiology the authors mention grip, exanthems, tonsillitis and adenoiditis. Hereditary syphilis usually causes chronic sinusitis. The symptoms described in the acute cases are nasal obstruction and discharge, oculo-orbital swelling, edema and chemosis. Because of the danger of meningitis and abscess of the brain the authors believe in early operation to establish drainage by the external route.

Laskiewicz [79] explains edema of the lids and orbital borders in cases of acute sinusitis of infants as being either of hematogenous or of lymphatic origin. In cases of the former type there may be loss of vision, thrombosis of the cavernous sinus or meningitis. In cases of the latter (lymphatic) there is a serous exudate into the orbital tissues. Edema of the forehead just over the supra-orbital margin results from acute or chronic infection of the frontal sinus: It is especially marked if the periosteum is inflamed. In addition, there may be swelling and redness of the conjunctiva. Headache, tenderness of the eyelids and inner orbital wall and later proptosis and chemosis complete the picture. In children past 8 years one may occasionally find edema of the lower border of the orbit due to disturbance of circulation. In children under 4 years the communication between the nasal cavity and the antrum is large enough to insure ventilation; consequently there is less danger of orbital complications.

78. Sargnon and Euvrard: Considérations cliniques et thérapeutiques sur les sinusites fronto-ethmoido-sphénoidales de l'enfance, Ann. d'oto-laryng., 1934, p. 499.

79. Laskiewicz, A.: Contribution à l'étiologie et au tableau clinique de l'oedème des paupières d'origine nasale chez les enfants, Ann. d'oto-laryng., 1934, p. 567.

In another contribution on the same subject the same author [80] discusses 18 cases with complications which he has observed since 1927. The ages of the patients varied from 4 months to 14 years. The distribution by involvement of sinuses was as follows: antrum, 3; ethmoid, 4; frontal, 1; (chronic) fronto-ethmoid, 4; antrum and ethmoid, 4; postinfluenzal fronto-ethmo-antrum, 1 (bilateral). In 1 case of postscarlatinal involvement of the frontal and ethmoid sinuses an extradural abscess developed with edema of the lids and conjunctiva. Operation was followed by recovery. In four cases of chronic involvement of the ethmoid sinuses and the antrums (ages, 8 months, 1, 2 and 3 years) marked edema of the lids disappeared under conservative treatment. The infective agents were short chain streptococci and pseudodiphtheria bacilli. In 1 case of orbital abscess in a 5 year old child with ethmofrontal suppuration due to short chain streptococci recovery occurred following operation. The author believes that infection is carried by way of preformed channels. Rarely does one find bony dehiscences.

Greenfield [81] goes into the subject of orbital complications in children in a very thorough manner. Ethmoiditis is frequently overlooked because the physician is thinking only of infection of the antrums. Conditions diagnosed as frontal sinusitis are often infection of the ethmoid sinuses. The maxillary and sphenoid sinuses never give rise to orbital complications in children. Because the bone is softer in children it is more readily invaded by infection from the underlying mucoperiosteum of the sinus. Swelling of the mucosa leads to early blocking of the small ostia of the cells, causing distention with obstruction to circulation. This leads to intra-orbital tension, edema and chemosis. Infection reaches the orbit by necrosis of the lamina, by dehiscences, along the channels of the blood vessels and through the blood stream. Absence of fixation of the bulb and induration of the orbital tissues means that the infection is still intralabyrinthine. Fixation is always an indication for surgical intervention. The nasopharyngoscope is of value in determining the intranasal status. One finds marked edema of the middle turbinate, especially at its posterior end, and edema of the mucosa in the recess between the turbinate and the lateral wall, often projecting beyond the turbinate. The roentgen picture in addition to showing cloudiness often discloses a displacement of the lamina due to swelling in the ethmoid labyrinth. Greenfield measures the width of the labyrinth from the bony septum high up where it is less likely to be deviated and can thus demonstrate differ-

80. Laskiewicz, A.: Les sinusites de l'enfance et leurs complications, Rev. de laryng. **55**:929, 1934.

81. Greenfield, S. D.: Acute Sinusitis in Children Associated with Orbital Complications: The Conservative Treatment, Laryngoscope **44**:683 (Sept.) 1934.

ences in width between the sides. He has found the affected side from 3 to 5 mm. wider than the unaffected side. Conservative treatment is advised in all cases unless induration and fixation of the bulb are present. Operation carries a risk of meningitis because of the wide foramina, open sutures, rich blood and lymphatic supply and thin bony partitions.

INTRACRANIAL COMPLICATIONS

Meningitis.—Ribollet [82] reports a case of streptococcic meningitis following an open fracture through the frontal sinus. In addition to thorough local cleansing and drainage, the treatment consisted of daily intramuscular injections of 40 cc. of antistreptococcus serum for four days. At this time the spinal fluid began to clear and was free of bacteria. On the fifth and sixth days the patient received 30 cc. of serum, and on the seventh, eighth and ninth days, 20 cc., at which time the temperature reached normal. The author refers to Vincent's report of 111 instances of recovery in 136 cases. In the discussion Métivet and Soupault report equally favorable results but recommend larger doses up to 100 cc. Moure calls attention to the variable character and virulence of the streptococcus, and states that he has used the serum with varying results.

Unterberger [83] agrees with Preysing that in cases of rhinogenous meningitis when it is necessary to expose the dura of the anterior fossa it is well not to disturb the area over the cribriform plate because of its close union with the bone and the ease with which it tears. This applies only when there is no evidence of an epidural abscess in this location. When such an abscess is suspected it is advisable to remove the lamina cribrosa, thus freeing the dura and permitting more ready evacuation of the pus. The author cites 1 case in which autopsy was performed in which the avoidance of the lamina cribrosa left an accumulation of extradural pus unevacuated and another case in which removal of this structure led to free drainage and cure.

Mayer [84] reports a fatal case of meningitis following an intranasal ethmoidectomy. Autopsy revealed an operative break in the roof of one ethmoid labyrinth and a laceration of the dura. The roof on this side was much lower than that on the opposite side. The surgeon had

---

82. Ribollet: Méningo-encéphalite diffuse à streptocoques consécutive à une fracture ouverte du sinus frontal: Guérison par le sérum antistreptococcique de Vincent associé au traitement chirurgical, Bull. et mém. Soc. nat. de chir. **60:** 930, 1934.

83. Unterberger: Grundsätzliches zur operativen Behandlung der rhinogenen Meningitis, Beitr. z. prakt. u. theoret. Hals-, Nasen- u. Ohrenh. **31:**193 (June) 1934.

84. Mayer, O: Ein Fall von tödlichen Meningitis nach intranasaler Siebbeinoperation, Ztschr. f. Hals-, Nasen- u. Ohrenh. **35:**379, 1934.

first operated on the opposite side and assumed its height to be the same as that on the affected side, with the result that he perforated into the brain thinking he was entering another cell. The author further submits sections from other skulls to demonstrate that inequality in the level of the cribriform plate and roof process of the ethmoid is not rare. He believes that exenteration of the ethmoid process cannot be carried out intranasally with safety. The only way to prevent accidents is never to work higher than the medial height of the cribriform plate, which is its lowest point. He also points out that work lateral to the middle turbinate is no insurance against the danger of perforation into the cranial cavity.

Halle,[85] in commenting on Mayer's article, states that in his experience he has seen not more than 1 fatality from meningitis in a thousand operations on the ethmoid process. He has never seen an operative laceration of the dura. Meningitis in his experience was the result of lymphogenous extension. He recommends various procedures to avoid injuring the roof of the ethmoid process or cracking the cribriform plate, such as splitting a bullous turbinate rather than removing it in toto and cutting through the walls of the cells and bases of polypi to prevent breaking the thin bone when the polypi are removed. He has seen dehiscences exposing the dura but believes that such exposure is no more dangerous than similar exposure of dura in mastoidectomies. His procedure in such cases is carefully to remove the diseased mucosa from the region of the exposed dura, blow in some iodoform powder and then pack the cavity lightly with iodoform gauze.

A fatal case of meningitis complicating acute infection of the sinuses in a child of 8 is reported by Schlindwein [86] because of the extensive involvement of the cranial nerves. Before the child died all the following nerves were involved: The second, third, fourth, fifth, sixth, seventh and possibly the ninth on one side and the third, fourth and sixth of the opposite side. As the parents refused permission to have the child removed to a hospital and to perform an autopsy, accurate information as to the pathologic process was lacking. The following conditions were ruled out clinically: tumor of the brain (because of too rapid progress and no atrophy of the optic nerve), basal poliomyelitis (because of the mode of onset, associated nausea and lack of definite constitutional manifestations), encapsulated abscess of the brain (because too many nerves were involved and there were no signs of pressure), tuberculous meningitis (because of too sudden onset) and

85. Halle, M.: Zu Otto Mayers Arbeit, Ztschr. f. Hals-, Nasen- u. Orhenh. **37**:71, 1934.

86. Schlindwein, G. W.: Sinusitis with Extensive Cranial Nerve Involvement, Pennsylvania M. J. **37**:733 (June) 1934.

epidemic encephalitis (because of the age of the patient and the lack of prodromal symptoms).

Abscess of the Brain.—In Friedrich's [87] case, which occurred during an epidemic of influenza, the abscess developed to a remarkable size without any previous nasal symptoms; at least, there was no spontaneous discharge of pus from the nose. Headache was a prominent symptom and was followed by vague rambling chatter, bradycardia, oculomotor paralysis and finally meningitis. The difficulty of diagnosis in this case was due to the absence of symptoms in the nose. Thus the abscess, which might have been disclosed earlier, was discovered when it was too late.

In Brown's [88] case frontal sinusitis complicated by an orbital abscess which was incised and drained was followed several weeks later by headache and vomiting. The sinus was opened, and pus was evacuated. Vomiting continued, and vision began to fail. The patient saw only the lower half of the right visual field, and there was an enlarged blindspot in the left eye. Two months later, the wounds being healed, the white blood cell count was still high and there were a few lymphocytes in the spinal fluid. The vision was still abnormal. In the right eye there were loss of the upper half of the visual field and marked papilledema, and the margins of the disks were blurred, particularly in the upper half. In the left eye there were an enlarged blindspot and papilledema, and the margins of the disks were obscured. The patient was operated on again. Both plates of the right frontal sinus were removed; the sinus was found to extend beyond the midline over to the left. A week later the wound was opened, and the right frontal lobe was probed without result. The left frontal lobe was then explored and revealed a large abscess. A split rubber tube was used for drainage, and the patient recovered. Staphylococcus aureus was found to be the chief offending organism. Examination five months later revealed only slight improvement in vision.

Davis [89] reports a fatal case of abscess of the frontal lobe developing one month after a blow. At first there was a supra-orbital abscess, which was evacuated. The patient gradually became drowsy and once probed the open wound himself, saying he could feel "something give way" (he may have perforated the inner wall of the sinus). Symptoms of abscess of the brain became more marked, and drainage failed to save the patient.

---

87. Friedrich: Ueber den rhinogenen Stirnlappenabscess mit einem kasuistischen Beitrag, Ztschr. f. Hals-, Nasen- u. Ohrenh. **35**:366, 1934.

88. Brown, L. G.: Right Frontal Sinus Suppuration with Orbital Abscess: Abscess of Left Frontal Lobe: Bilateral Visual Defects: Recovery with Partial Blindness, J. Laryng. & Otol. **49**:686 (Nov.) 1934.

89. Davis, E. D.: Two Cases of Abscess of Frontal Lobe, J. Laryng. & Otol. **49**:688 (Nov.) 1934.

Another case reported by the same author presented some remarkable features. A youth of 17 fell on a curb five years before examination, striking his right temple. He was unconscious for a short time but recovered without any further disturbances and was without symptoms up to three months before examination, when headache developed. More recently the headache increased in severity, his memory began to fail and vertigo ensued. Both optic disks and fundi were congested; the outer margin of the disk of the left eye and the upper and inner margins of the disk of the right eye were ill defined. The pupils were normal: There were an increased knee jerk on the left and stiff neck. Later, drowsiness and coma developed. Optic neuritis increased, and a small corneal ulcer appeared accompanied by subnormal temperature, ankle clonus and a Babinski sign. Autopsy disclosed a slate pencil passing through the antero-internal portion of the orbital plate in the region of the anterior ethmoid cells. It had penetrated 2 cm. from the nose into the anterior fossa of the skull and was firmly fixed. The dura had not been perforated, but there was a large intracerebral abscess of the frontal lobe. Just to the left of the mesial fissure in front of the olfactory bulb was a slightly depressed area covered by thickened opaque pia-arachnoid which lay in contact with the slate pencil. The cavity of the abscess had a thick fibrous capsule and contained thick, foul pus. A displaced rubber drainage tube previously inserted was also found. Davis calls attention to his experience in the World War with such cases. All patients with abscesses drained with a rubber tube died of meningitis on the fifth or sixth day. On the other hand, more than half of the patients treated by irrigation with Ringer's solution, removal of débris and primary closure recovered.

Canuyt and Wild [90] report a case of abscess of the frontal lobe in a child of 11 in whom there was no infection of the sinuses. The child was hit over the left inner canthus by a branch of a tree, had streptococcic meningitis and recovered. After two months of well-being, symptoms of abscess of the brain appeared. Roentgenograms showed destruction of the sella turcica. Exploration of the left frontal lobe revealed an abscess at a depth of 3 cm., which yielded 75 cc. of pus. Twenty cubic centimeters of antipneumococcus serum was given. Relief was only temporary, and a few days later the symptoms of pressure reappeared. The abscess was again punctured and irrigated with a 1 per cent solution of optochin hydrochloride and a large drain inserted. Irrigation was repeated in a few days. Pus showed pneumococci on culture. The patient recovered. The authors cannot explain why a pneumococcic abscess developed after streptococcic meningitis.

90. Canuyt, G., and Wild, C.: Abcès à pneumocoques du lobe frontal gauche: Intervention chirurgicale, abcès de fixation, sérum antipneumococcique, lavage à l'optochin; guérison, Ann. d'oto-laryng., 1934, p. 619.

In Cariss' case [91] acute involvement of the frontal sinus was followed within sixty hours by headache, swollen lids and convulsions. The symptoms abated in the first five days, while associated nephritis and pneumonia complicated the picture. There were no ocular findings and no elevation of temperature and the spinal fluid was normal up to four days before death. Changes in personality and motor aphasia appeared rapidly, and operation disclosed multiple discrete nonencapsulated abscesses, of which the patient died. Several authors are quoted on the bad prognosis in cases of acute nonencapsulated abscess.

Wolff [92] reports a case of abscess of the frontal lobe which he ascribed to a hematogenous infection. Osteomyelitis was also present. He calls attention to the great difference between the pulse rate with the patient in the sitting position and that with the patient in the reclining position (20 beats). He says this symptom was reported by both Goldstein and Kaila in several cases as being due to acute disturbance in the cerebrospinal fluid pressure. The author's patient recovered following operation according to the Lemaitre technic. Six months after operation the spinal fluid cell count was still increased. Two weeks after operation irregular nystagmus appeared, which persisted. The author ascribes it to cicatricial constriction of the frontocerebellar pathway.

Another case of a patient with a history of trauma is recorded by Gordon.[93] A boy aged 11 was hit by a baseball bat three years before examination but suffered no apparent ill effects. There were no symptoms up to three months before examination, when pain and local swelling appeared. Temporary improvement followed incision, but the symptoms increased in severity, with bilateral papillitis with edema, concentric contraction of the visual fields, exaggerated nystagmus from rotation and persistent past-pointing. Roentgenograms showed erosion of both plates of the sinus. Operation disclosed two abscesses with capsules. Death occurred as a result of rupture into the ventricle. The author explains the contralateral past-pointing and poor pelvic girdle as due to involvement of the posterior part of the frontal lobe.

In Mollison's case [94] there were surprisingly few symptoms for the amount of pathologic change. Roentgenograms showed clear frontal sinuses, and aside from headache, slightly elevated temperature, weak-

91. Cariss, W.: Acute Frontal Sinusitis and Pain Abscess, Laryngoscope **44**:612 (Aug.) 1934.

92. Wolff, E.: Beitrag zur Frage der Hirnabscesse nach Lemaitre, Finska läk.-sällsk. handl. **76**:122, 1934.

93. Gordon, W.: Frontal Lobe Abscess (Multiple) Secondary to Frontal Sinusitis with Report of a Case, Laryngoscope **44**:717 (Sept.) 1934.

94. Mollison, M. W.: Case of Suppuration of the Right Frontal Sinus Not Revealed by X-Rays: Sudden Death; Large Abscess in Frontal Lobe, J. Laryng. & Otol. **49**:48 (Jan.) 1934.

ness of grip of hand and an exaggerated knee jerk there was nothing definite. Death occurred suddenly about two weeks from the onset of the rhinitis, and at autopsy a large frontal abscess with no local meningitis was disclosed. Operation had not been performed because the roentgen findings were negative and the headache was thought to be due to a concurrent infection of the antrum.

Extradural Abscess.—Bozzi [95] reports the case of a man of 52 who died of pulmonary gangrene and bilateral chronic frontal sinusitis in whom at autopsy a large extradural abscess was uncovered on the left side which was encapsulated by bone and communicated with the sinus by a small fistulous opening. The patient had complained of frontal headache for two years with slight exophthalmos. In a discussion of the bony encapsulation of the abscess the author expressed the opinion that it was due to the stimulation of the pus, causing bony metaplasia in a favorably predisposed floor, namely, the pachymeninges. Ossification of the dura has been recorded in the falx cerebri. The pulmonary focus in this case must have been metastatic.

Thrombosis of Cerebral Veins.—Konietzko [96] reports 3 or 4 cases of sepsis complicating frontal and maxillary sinusitis in which thrombosis of an emissary vein was thought to be the focus. In 1 case the author was able during operation on the frontal sinus to demonstrate a communicating vein filled with pus which was lying near the top of the internal wall of the sinus. It was identified as a thick, white shiny strand the size of a knitting needle running toward the midline, where it emptied into the superior longitudinal sinus. At autopsy on another patient, who died of septicemia, an extradural abscess was disclosed lying on the pars basillaris of the occipital bone. The maxillary sinus on one side was necrotic and full of pus. There was caries of its posterior wall with erosion into the pterygopalatine fossa, which was infected. Veins passing into the vidian canal were thrombosed. Communicating veins about the internal carotid artery were thrombosed, thus carrying infection to the base of the posterior fossa.

OSTEOMYELITIS

Dixon [97] reports 11 cases in detail and concludes that conservative treatment offers the greatest hope for cure. He stated:

> Since it is an accepted fact that surgical trauma to the acutely infected frontal sinus frequently produces osteomyelitis of the cranial vault, then it is only logical

95. Bozzi, E.: Sinusite frontale, Arch. ital. di otol. **46**:573, 1934.

96. Konietzko, P.: Venethrombose, Pyämie und Septikämie bei Stirn- und Kieferhöhlenempyem und bei isolierter Thrombose des Emissariums, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **138**:20 (March) 1934.

97. Dixon, O. J.: Diffuse Cranial Osteomyelitis Complicating Frontal Sinusitis, Ann. Otol., Rhin. & Laryng. **43**:16 (March) 1934.

to assume that similar procedures on acutely infected bone elsewhere in the cranial vault would serve to spread the disease. . . . Even when the disease is recognized early, and where every opportunity is offered for surgical relief, operative interference should be delayed until the acute bone infection has subsided. . . . Surgical intervention on the acutely infected bone in no way controls the spread of the disease but, on the contrary, is more apt to cause it to spread. . . . Surgical interference during this acute stage disturbs the normal blood supply to the affected part and inhibits nature's effort to control the disease.

The author expresses the opinion that treatment should be limited to simple drainage and removal of sequestrums as they are diagnosed and only when they are acting as foreign bodies. Complications should be handled as they arise.

Osteomyelitis of the superior maxilla occurs frequently in young children, according to van Gilse,[98] because the bony case of the maxillary sinus is not completely closed in and therefore infection may readily pass from the nose via the sinus to the tooth-buds. Most frequently the molar and canine tooth-buds are affected. Infants with sequestrating osteomyelitis should be operated on externally, the incision being made along the orbital margin to avoid the tooth-buds. In 3 of the author's cases the zygomatic cells were affected. The author believes that ozena is often the result of infection of the sinuses in infants.

Mithoefer[74] is not certain whether infection of the antrums or trauma to the tooth-buds at birth is the cause of osteomyelitis in children. He gives the following as the principal symptoms: nasal discharge, infiltration of the alveolar ridge, possibly an external fistulous opening, swelling of the face extending up to the eye with swelling of the lids and, occasionally, exophthalmos.

Schröder[99] cites a case in which erysipelas developed two years after a radical operation on the antrum in a woman of 45. Erysipelas proved to be very extensive, spreading over the entire body. When it had completely subsided it was found that tenderness and swelling persisted over the affected antrum, spreading to the side of the head. Roentgenograms showed extensive clouding, diffuse shadows and evidence of sequestrums extending as far as the superior sagittal sinus. These were removed, but later during an afebrile period a new swelling appeared over the zygoma. Histologic examination of a biopsy specimen revealed a squamous cell carcinoma which grew very rapidly. The patient died within four months.

The author calls attention to the fact that erysipelas may be associated with underlying osteomyelitis. Early diagnosis of the latter con-

98. van Gilse, P. H. G.: Die pathologische Bedeutung der Nebenhöhlen der Nase bei kleinen Kindern, Maandschr. v. kindengeneesk. **3**:431, 1934.

99. Schröder, F.: Diffuse Osteomyelitis der Schädelkapselknochen im Anschluss an eine Nasennebenhöhlenerkrankung, Chirurg **6**:412 (June) 1934.

dition is important if its spread is to be halted. The author is one of those who favors early operation. Anastomosis with veins of the dura may lead to serious complications. The incidence of carcinoma in his case is rather unusual. It was not discovered at the time the patient was operated on for the osteomyelitis, and the author believes it must have developed during the acute exacerbation and not as a residue of the old infection.

Kaufman and Hartmere [100] report in detail the history of a case of chronic maxillary and ethmoid sinusitis in a girl of 18. Headache and postnasal discharge increased in severity over a period of four years and finally led to a series of operations beginning with the removal of polypi, intranasal evisceration of the ethmoid sinuses and radical operation on the antrum. A severe postoperative hemorrhage necessitated a nasal pack, following which symptoms of meningitis developed, the diagnosis of which was confirmed within a few days by spinal puncture. Death occurred suddenly. At autopsy pus was revealed in both the ethmoid and the sphenoid sinuses and osteomyelitis of the roof of the sphenoid bone with a direct opening into the sella turcica. The authors expressed the opinion that early roentgen study and intervention for drainage of the sphenoid sinuses should be done in all cases of headache and postnasal discharge. They quote St. Clair Thompson, who reported a series of cases of meningitis and cavernous sinus thrombosis due entirely to infection of the sphenoid sinuses. They also cite Eagleton on the diagnostic value of pain in the top of the head as indicative of sphenoiditis.

BENIGN NEOPLASMS

Miscellaneous.—Alonso and Pietra [101] reported 11 cases of solitary nasal polypus, in 8 of which the polypus was shown to have arisen from the alveolar recess of the maxillary sinus. Diagnosis was made by transillumination, roentgenogram and contrast mediums. The frequency of origin from the alveolar recess corroborates the view of Molan, who claims that these tumors are of dental origin and therefore suggests that in such cases one should investigate the condition of the teeth.

Hinnen [102] describes a case of a tumor in the inner upper angle of the orbit. The frontal sinus was opened and was found to be filled with pultaceous masses mixed with thin pus of foul odor. It also contained

100. Kaufman, A., and Hartmere, S. J.: Latent Osteomyelitis of the Sphenoid Bone Reactivated by Trauma with Death from Meningitis, Laryngoscope **44**:477 (June) 1934.

101. Alonso, J. M., and Pietra, R.: Die Solitärpolypen der Nasenhöhlen, An. d'oto-rhino-laring. d. Uruguay **3**:204, 1934.

102. Hinnen, A. B.: Vereterde dermoidcyste in der Voorhoofdsholte, Nederl. tijdschr. v. geneesk. **78**:2090 (May 12) 1934.

numerous black hairs averaging about 0.5 cm. in length. The interfrontal septum was eroded, and the opposite frontal sinus also contained masses of hair. The authors state that embryologically it is not likely that the dermoid cyst originated in the frontal sinus. They expressed the opinion that previous trauma may have caused a nearby cyst to grow toward and into the sinus. It is also possible that the cyst was not congenital but resulted directly from trauma. Another possibility is that a congenital cyst in its growth may have caused pressure absorption of the bony wall of the sinus and have broken into the sinus as a result of trauma or incidental infection of the sinus.

Nogao [103] reports a case in which two choanal polypi grew from the same side in a boy of 16. One came through an accessory maxillary ostium and the other from an operative opening in the inferior meatus. In another case, in a man aged 23, a large choanal polypus was thought to be of antral origin. The antrum was opened as for a radical operation when it was discovered that the growth came not from the maxillary but from the sphenoid sinus. It was removed by way of the antrum.

Riegele [104] reports a rare case of papilloma of the maxillary sinus which was not diagnosed until operation. The patient, a youth of 19, had previously suffered from osteomyelitis of the upper jaw. His teeth had to be drawn, and for several years he had been wearing a plate. The antrum was operated on for the relief of chronic sinusitis, at which time the growth was discovered. The author points to the importance of histologic examination of all tissue removed from the antrum at operation because of the malignant tendency of apparently benign growths, especially papilloma.

Osteoma: Mucocele: Pyocele.—Jeschek [105] encountered an osteoma the size of a man's fist involving both frontal sinuses of a man of 23. An intercurrent local infection causing elevation of temperature, pain and impaired vision brought the patient to the hospital, where roentgenograms disclosed the growth. Incision and evacuation of pus were followed by an attempt at removal of the tumor a week later. It was found to have originated from the anterior wall, growing deeply into the sinus cavity and invading its posterior wall, the ethmoid cells and the opposite frontal sinus. Radical removal was impossible because it encroached on the lamina cribrosa in the midline. A permanent fistula

103. Nogao, S.: Beiträge zu Choanalpolypen: I. Zweiköpfige Antrochoanalpolypen; II. Sphenochoanalpolyp, Otologia, Fukuoka **7**:19, 1934.

104. Riegele, L.: Ueber primäre Papillome der Kieferhöhle, Ztschr. f. Laryng., Rhin., Otol. **25**:267, 1934.

105. Jeschek, J.: Ueber das Verhalten der Stirnhöhle beim Osteom, Monatschr. f. Ohrenh. **68**:1107, 1934.

was left on one side, relieving the symptoms, but roentgenograms a year later showed much of the mass still present.

Patriarca and Giochino [106] describe a case of osteoma occurring in conjunction with a mucocele in a man of 75. The symptoms were swollen eyelids, exophthalmos and tenderness over a circumscribed area of the frontal bone. Roentgenograms revealed a dense shadow at the inferior internal angle of the sinus. The diagnosis of osteoma and mucocele was corroborated at operation. The authors are of the opinion that the mucocele developed independently of the osteoma on a congenital basis, because there was an extremely bullous middle turbinate.

Baldenweck and his associates [107] assembled reports on 88 cases of pneumatocele from the literature, only 7 of which were associated with osteoma. They report the case of a young woman who was struck on the forehead with a tennis ball. For the ten months following she suffered numerous attacks of severe frontal pain accompanied by a bubbling sensation. Roentgenograms showed a large pneumatocele and osteoma in the frontal area. Seen from the side the pneumatocele looked like a balloon on which the osteoma lay like a basket. It appeared to be extradural. The authors explain the association of the two conditions in this manner: The osteoma was undoubtedlly present for a long time, involving the inner table of the sinus and elevating the dura. The blow on the forehead caused a fracture of the inner table, producing a communication between the sinus and the extradural space. Air then easily passed into this space from the sinus, causing the pneumatocele. The authors believed that most of the air would be absorbed. They planned to make roentgenograms from time to time as symptoms appeared. They quote Worms to the effect that in a series of 72 cases, in which operation was performed in 35 and expectant treatment followed in 37, the number of recoveries and fatalities was the same regardless of treatment, with the advantage slightly in favor of nonoperative treatment.

A similar case with more serious and widespread complications is reported by Bell.[108] A man of 28 sustained an injury to the forehead while playing football. At the end of a year he still had weakness of the arm and leg on the opposite side. A few months later headache

106. Patriarca, A. P., and Giochino, R.: Osteoma primitivo del sino frontale concomitante a mucocele fistolizzato nell'orbita in correspondenza dell'angelo supero-esterno, Riv. oto.-neuro-oftal. **11**:153, 1934.

107. Baldenweck, L., et al.: Pneumatocèle frontal interne au cours de l'évolution d'un ostéome du sinus frontal, Ann. d'oto-laryng., 1934, p. 657.

108. Bell, F. G.: Intracranial Pneumatocele (Pneumo-Cephalus) Associated with an Orbito-Ethmoidal Osteoma, Australian & New Zeland J. Surg. **4**:70 (July) 1934.

and blurred vision appeared. The patient was finally able to return to work, but for six years was troubled with weakness of the arm and leg. During the four years before examination he suffered attacks of jacksonian epilepsy. Examination revealed paralysis of the left side of the face, spastic paraplegia on the left side, intense headache, drowsiness and normal spinal fluid. Roentgen examination revealed an "osteoma arising from the orbital plate of the right frontal bone close to the midline and encroaching on the sinus. There was extensive pneumocephalus on the right side with displacement of the falx and compression of the brain substance. The air probably lies in the subdural space." With the area under local anesthesia a right frontal osteoplastic flap was laid back. The dura was dense and the frontal lobe tympanitic. On puncture much air escaped, and this was followed by collapse of the frontal lobe. The dura was stripped downward to the base, following the orbital plate, until the osteoma was reached. A projecting spike of the osteoma had punctured the dura. The latter had to be incised and freed to expose all the growth. Its size was 2.5 by 1.25 by 1.25 cm., and its surface was studded with spiculated tuberculations. "It was traversed at its attachment to the floor of the skull by a small foramen ('the minute pneumatic sinus' of Cushing) which clearly transmitted air at each inspiration from the ethmoidal cells below to the subdural space above by way of the breach in the dura referred to previously." After the growth was removed the author placed a sheet of rubber drain against the exposed brain and packed the wound with iodoform gauze. He mentions Cushing's preference for fascia lata in such cases.

A pyomucocele of the fronto-ethmoid process is reported by Geschelin.[109] A woman of 23 had been operated on thirteen years previously by the external route for acute suppuration of the ethmoid sinus. There were no symptoms for eleven years, when lacrimation became noticeable, followed by the appearance of a small tumor at the inner corner of the eye, which seemed larger in the morning than in the evening and gradually increased in size. It was tense but not tender and pushed the bulb downward and outward. Roentgenograms showed the ethmoid area widened and a definite defect in the orbital wall of the frontal sinus. At operation the frontal, ethmoid and sphenoid sinuses were found to be filled with a thick homogeneous mass. A few bony septums were still present. Removal of the bulla provided a wide communication with the nasal cavity. The author ascribes the condition to inadequate intranasal drainage at the operation performed in childhood. The nasofrontal duct became closed, and secretions were retained and increased

109. Geschelin, A. I.: Pyo-mucocele fronto-ethmoidalis, Acta oto-laryng. **21**: 377, 1934.

through recovery of the mucosa, which led to enlargement of the space until adjacent bony walls were absorbed.

Zöllner [110] seeks to discover how and why the nasofrontal duct becomes closed in such cases. Also, he desires to know whether the purulent inflammation is primary and how it persists without breaking through externally. Pyomucoceles and mucoceles have been proved histologically to be not true cysts but cavities lined with altered mucosa of the frontal or ethmoid sinuses. Trauma and osteoma have in some cases been shown to be the cause of blockade of the nasofrontal duct. Killian and Gerber have proved the suppurative genesis of pyocele through closure of the duct. Hajek states, however, that pyocele is secondary to infection of a mucocele. In Zöllner's first 2 cases there was definite evidence that the pyocele originated from a previous acute infection of the sinus. In one case there was inflammatory swelling with polypi, granulation tissue and osteophytes blocking nasal drainage. In another case there was complete fibrous closure of the duct. He concludes that in one group the pyocele arises from empyema of the sinus in which the duct becomes blocked by swollen mucosa which in time may lead to formation of fibrous tissue. In some instances a mucocele or an osteoma becomes secondarily infected through trauma. The author agrees with Killian and Gerber that infection may cause closure of the duct and lead to accumulation of secretions and subsequent dilatation through pressure.

Alpin [111] also believes that inflammatory obstruction of the nasofrontal duct is the cause of pyocele. In his case, however, periodic discharge from the nose prevented the mass from eroding the external plate of the sinus, although it extended into the orbit, eroding the lamina papyracea and the floor of the frontal sinus. An operation according to the technic of Riedel through the Preysing incision was necessary because it was found that the upper three fourths of both nasal bones and frontal processes of the superior maxilla had been destroyed. The mass when first seen was the size of a hen's egg and extended across the root of the nose into both orbits.

Dentigerous Cysts.—Love [112] states that the definite etiology of these cysts is unknown. He thinks that they may be due to retention of fluid in the stellate reticulum of the tooth follicle situated between the cuticular dentin and the crown of the tooth which distends the follicle into a cyst lined with epithelium. The cysts may also develop from the

110. Zöllner, F.: Verschlüsse des Ductus naso-frontalis und Pyozelenbildung, Beitr. z. prakt. u. theoret., Hals-, Nasen- u. Ohrenh. **31**:47, 1934.

111. Alpin, J.: Zur Kasuistik der Pyocele ethmoidalis, Monatschr. f. Ohrenh. **68**:1009 (Aug.) 1934.

112. Love, A.: Cysts of the Antrum: Report of Two Cases, Arch. Otolaryng. **19**:348 (March) 1934.

so-called epithelial rests of Malassez. The symptoms are few. Pain is rare. The growth is usually first noticed when the deformity due to pressure on the antral wall, the palate or the nasal passages is seen. The contents usually consist of thin, straw-colored fluid with cholesterol crystals and partial or whole teeth. The treatment consists of complete removal of the cyst including its bony shell by way of the usual Caldwell-Luc incision and establishment of drainage into the nose through the inferior meatus.

Mackenzie [113] subscribes to the Malassez theory, viz., that the cysts are due to epithelial rests of the enamel germ. He reports a case of multiple cysts, there being three in each antrum, none smaller than a bean. They were overlooked until roentgenograms were made. Because of associated suppuration bilateral evisceration was done by the Caldwell-Luc technic on one side and by Denker's technic on the other.

McGuire and Harris [114] believe in the theory of Bland-Sutton that these cysts are due to expansion of the tooth follicle. In the case they report the process was developing for nearly ten years. The patient complained of fulness in the cheek. There was a springy swelling just below the eye. Injection of iodized poppy-seed oil 40 per cent into the antrum outlined the cyst, which was located in the upper part of the sinus. It was large and unilocular and by pressure had caused absorption of the superior lateral nasal wall and asymmetry of the infra-orbital anterior wall of the sinus.

MALIGNANT NEOPLASMS

Ohngren [115] describes the progress in the treatment of malignant processes of the upper jaw and sinuses since the introduction of electrocoagulation in Sweden in 1922. The patient is free from shock following its use, healing is rapid, and recurrences are less frequent. All patients received both preoperative and postoperative irradiation at Radiumhemmet. In most instances the operation was done without external incision. In a few selected cases of tumor of the anterior portion of the palate or the alveolar process coagulation alone was employed. A macroscopically healthy ethmoid process frequently proved to be diseased on microscopic examination. The author recommends thorough coagulation in the pterygopalatine fossa in order to destroy the lymphatics, which may contain tumor cells. He uses local anesthesia or a combination of local and general. The external

113. Mackenzie, G. W.: Report of a Case of Multiple Dentigerous Cysts Involving Both Maxillary Sinuses, Laryngoscope **44**:621 (Aug.) 1934.

114. McGuire, I., and Harris, H. L.: Dentigerous Cyst of Maxillary Antrum with Unusual Variations, Laryngoscope **44**:306 (April) 1934.

115. Ohngren, G.: Ueber die Behandlung der bösartigen Geschwülste des Oberkiefers und Siebbeins aus der Ohrenklinik Sabbatsberg in Stockholm, Nord. med. tijdschr. **7**:135 (Feb. 3) 1934.

carotid artery was ligated in half of the cases. In the clinic from 1924 to 1931 treatment was given in 111 cases of carcinoma, 20 of sarcoma and 11 of malignant tumor of the mucous and salivary glands. Metastases were present in 25 per cent of all cases. The orbit was involved in 33 per cent. The results in the entire series were as follows: 44 per cent of the patients were symptom-free for two years, and 38 per cent were free from recurrence for from five to nine years. By comparison the author cites the published results of other authors. Hautant found 31 per cent of 42 patients free from disease for two years; Denker, 17 per cent of 61 patients; Pichler, 20 per cent of 125 patients, and New, 32 per cent of 97 patients. The author expresses the opinion that the technic of electrocoagulation cannot be improved but that the results will improve with earlier diagnosis, increasing effectiveness of radium and better central control of the cases.

At the November 7 meeting of the staff of the Mayo Clinic, New and Cabot [116] presented an abstract of a paper which is to appear elsewhere in full. It deals with a study of the cases of 295 patients with a malignant process of the upper jaw and antrum operated on prior to Jan. 1, 1929. In 141 cases there was a malignant process of the antrum, in 91, primary carcinoma, and in 50, secondary carcinoma; in 154 cases the process involved the upper jaw. The authors state that it is important to differentiate tumors arising in the antrum proper from those arising in the upper jaw itself, because of the difference in prognosis. They employed nitrous oxide anesthesia intratracheally and usually attacked the tumor through the mouth above the alveolar process or through the palate, depending on the situation of the growth. Occasionally lateral rhinotomy was performed. Frozen sections were prepared immediately in all cases. The treatment consisted of thorough destruction of the mass by diathermy, the establishment of drainage and follow-up treatment with radium. The results were tabulated as follows:

Condition	No. of Patients	No. Traced	Percentage Living 5 Years After Operation
Primary carcinoma of the antrum	91	75	40.0
Primary and secondary carcinoma of the antrum	141	118	44.9
Malignant process of the upper jaw including the palate	154	118	62.7
Malignant process without glandular involvement	...	104	68.3
Malignant process with glandular involvement	...	15	26.7

Only one postoperative death occurred caused by bronchopneumonia.

116. New, G. B., and Cabot, C. M.: The Curability of Malignant Tumors of the Upper Jaw and Antrum, Proc. Staff Meet., Mayo Clin. **9**:684 (Nov. 7) 1934.

Davis'[117] results were not as favorable as those in the cases just cited. His 50 cases are divided into two groups: (1) 9 cases in which the tumor began in the alveolus or hard palate near the molars and either infiltrated the cheek or broke into the antrum and (2) 41 cases in which the tumor began in the upper part of the nose, 15 in which it originated in the floor of the orbit near the infra-orbital canal and 10 in which its origin was in the ethmoid process. The process was more malignant in the latter group than in the former. The principal symptom was persistent pain in the cheek radiating to the frontal or temporal region. Nasal hemorrhage from unusual sites is very suspicious. Early transillumination, roentgen study and exploratory operation are urged by the author as essential to early diagnosis. Eight patients in group 1 were treated by diathermy. There were recurrences in 5 by the end of a year and in the other 3 at the end of two years. The author believes that he should have gotten better results than he did. Of 41 cases in group 2, the condition in 7 was inoperable. In 6 of the remaining 34 cases the patients were free from disease after two years (2 of these had endothelioma). The author is not favorably inclined to the use of radium either preoperatively or postoperatively because of the danger of sepsis and inflammatory reaction. He did, however, obtain some favorable results from the application of small amounts of radium to the surface several weeks after operation.

Clark[118] reports that his best results in the treatment of malignant processes of the antrum were obtained with electrocoagulation. He is not in favor of applications of radium within the antrum because of the danger of late necrosis. He thinks teleradium much safer and roentgen rays less effective. Preoperative irradiation is indicated only if the tumor is radiosensitive and is not progressing too rapidly. Neoplasms of the ethmoid, frontal and orbital sinuses likewise should be treated by electrosurgery. It is necessary to make wide excision including the overlying soft tissues. The author's conclusions are based on observations on 300 cases, but no statistics are given.

Watson-Williams[119] favors treatment with radium alone in cases of malignant processes of the sinuses. Of 10 patients thus treated, 9 were alive and did not have a recurrence three and a half years after treatment. When the antrum alone is involved the author recommends "per-oral antrostomy, with removal of a considerable part of the bony anterior wall, and free exposure of the interior, but minimal distur-

117. Davis, E. D. D.: Carcinoma of the Maxilla and Ethmoid: A Survey of the Notes of Fifty Cases, Brit. M. J. **1**:53 (Jan. 13) 1934.

118. Clark, W. L.: The Management of Neoplastic Lesions of the Accessory Sinuses and Orbit, Arch. Phys. Therapy **15**:333, 1934.

119. Watson-Williams, E.: Cancer of the Nasal Accessory Sinuses with Reports of Thirteen Cases, Practitioner **133**:717 (Dec.) 1934.

bance of the contents of the antrum; careful placing of needles containing radium (with 0.6 platinum screen preferred) all round the walls, retaining them in place, if necessary, with packing brought out through a per-nasal opening; closure of the oral incision." For treatment of malignant processes in the ethmoid sinuses he proceeds by "passing needles through the skin along the inner wall of the orbit and lamina papyracea; and by introducing needles into the ethmoid cells via the agger and bulla cells per-nasal route. Irradiation of the whole of the inner surface of the affected tissues by needles supported in the nose on a flexible wire frame, moulded into place under direct vision through the nostril; this frame is well tolerated and causes little obstruction; it is made of silver wire of about 20 gage. Pack (about 4 milligram hours) or x-ray treatment of glands if affected or suspected: in early cases, when the glands appear normal, they have not been treated."

The total dose with the needles amounts to from 2.5 to 4 mg. hours. The exposure lasts from 7 to 10 days. Fixation of the needles is important, and every known affected part must be exposed to two needles at not more than 1 cm. distance. The author does not recommend block dissection of the glands.

Fenton [120] writes most sympathetically of the sufferings of patients with resistant destructive and progressive malignant processes of the sinuses which invade the orbit and cranial cavity with all the attending symptoms of pain, blindness and deformity. He describes several cases in which early diagnosis was missed. In 1 case a spongy alveolar process and granulomatous masses persisted for one year following the extraction of a tooth before treatment was begun. In another case failing vision was the earliest symptom of an adenocarcinoma of the ethmoid process. In a third case there was recurrence of a carcinoma in the lacrimal area twelve years after an apparent cure of a cutaneous carcinoma of the nasal bridge. In a fourth case, after the removal of teeth for the treatment of pyorrhea tingling sensations developed and a sanguinopurulent discharge. Operation disclosed the antrum full of tissue and its walls already softened. In cases in which there is extensive infiltration wide excision is required followed with diathermy and radium. The latter, in Fenton's experience, proved to be only of temporary benefit.

Shutes [121] reports a case in which a papillary carcinoma of grade 2 of the nose and antrum has remained cured since 1928. Through an oral incision the growth was destroyed by desiccation and electrocoagulation. Six high voltage roentgen treatments were given in six

120. Fenton, R. A.: Some Annoyances in the Management of Malignancies of the Accessory Sinuses, Ann. Otol., Rhin. & Laryng. **43**:39 (March) 1934.

121. Shutes, M. H.: Cured Carcinoma of Nose and Antrum, Laryngoscope **44**:924 (Nov.) 1934.

days for a total of 1,350 roentgens with a 5 mm. copper and 1 mm. aluminum screen. Sloughing followed. One week later the patient received 500 mg. hours of radium with a 1 mm. brass and 2 mm. rubber screen applied through the nostril and followed by another application of 750 mg. hours. Six months later there was administered to a suspicious area near the alveolar opening 1,200 mg. hours of radium applied directly in the antrum. There had been no recurrence to the time of writing.

Geschelin [122] reports a case of primary carcinoma of the frontal sinus in a man of 40. One month following an attack of grip there were severe unilateral headache and failing vision. On examination the following findings were recorded: ptosis, exophthalmos, paralysis of the sixth nerve and branches of the third, atrophy of the optic nerve, tortuous veins of the disk, roentgen shadows filling the sphenoid sinuses and extending forward into the ethmoid process, cloudy frontal sinuses with obscure margins in one, irregular defects of the inner border of the orbits and bleeding granulations under the middle turbinate. An external operation was performed by Killian's method of exposure with the patient under chloroform anesthesia. A tumor filled the frontal, ethmoid and sphenoid sinuses. The dura behind the frontal sinuses was exposed through bony absorption. There was severe bleeding, and the operation could not be completed. Histologic examination of the tissue revealed alveoli of varying size filled with small cells and round, deeply staining nuclei with numerous mitoses and interalveolar stroma rich in small vessels and numerous cells. Pachymeningitis and possible abscess of the frontal lobe followed. Permission for autopsy was not obtained. The author is certain that the growth started in the frontal sinus, because there he found the greatest amount of destruction, all the walls being broken down. Furthermore, the syndrome of paresis of the abducens nerve with deviation of the eye downward and outward and the rapid development of amaurosis speak for a tumor growing from above and behind the eye rather than from the side, as would have been the case had it started in the region of the ethmoid sinuses.

A case of sarcoma of the upper jaw is recorded by Sukhavanam.[123] A boy of 4 presented a hard bony swelling of the right side of the upper jaw of four months' duration and increasing rapidly. The right eye was masked by swelling, and the lids could hardly be separated. The bridge of the nose was deflected to the left, and the right nostril was blocked. The antrum was opened through a sublabial incision and pus was drained without giving relief. Subsequently a Moure opera-

122. Geschelin, A. I.: Zur Klinik der bösartigen Neubildungen in den Nebenhöhlen der Nase: Primäres Karzinom der Stirnhöhle, Acta oto-laryng. **21**:351, 1934.

123. Sukhavanam, B.: A Case of Sarcoma of the Upper Jaw with Sinusitis of the Antrum of Highmore, Indian M. Gaz. **69**:510 (Sept.) 1934.

tion was performed and the mass removed. The flap was sutured, and drainage was effected through the alveolar opening. Recovery was complete within one month. There is no mention of histopathologic observations.

Von Eicken [124] described a case of hypernephroma of the ethmoid process in a man of 67. A large pulsating tumor was present at the internal canthus, extending to the frontal area. Aneurysm was considered one of the possibilities. At several spots on the surface one could detect parchment-like crepitation. The eye was displaced downward and outward. The fundus was normal. Roentgenograms showed absorption of the frontal process and the floor of the frontal sinus. The operation was very bloody. The mass contained a large quantity of yellow, sticky, more or less crumbly thin masses. Histologically the masses proved to be hypernephroma and possibly also endothelioma. A roentgenogram disclosed a hypernephroma. Roentgen treatments caused a slow recession of the tumor, but the end-result was still in doubt.

Kooper [125] reports 2 cases of solitary plasmocytoma of the nose and antrum in the left side confirmed by biopsy. Lateral rhinotomy was followed by the application of radium (6,700 mg. hours in two applications). He also reports a case of rhabdomyoma involving the maxillary sinus and eroding all the bony walls of the cavity down to but not including the palatal mucosa. The sphenoid and ethmoid sinuses were also invaded. Lateral rhinotomy was performed, followed by the application of 1,800 mg. hours of radium. His conclusions are as follows:

1. Solitary plasmocytomas and multiple myelomas belong to the general class of malignant lymphomas. Histologically they are identical though clinically different.

2. Thirty-two cases of plasmocytoma have been reported in the literature, most of them in the upper respiratory tract.

3. Combination of surgery and radium gives the best results.

Plasmocytoma of the upper respiratory tract is usually single: the glands are rarely involved. The tumor grows by contiguity, and metastases are rare. It is a malignant round cell tumor full of plasma cells and similar to a myeloma.

SURGERY

On the Maxillary Sinus.—The intranasal operation on the antrum is championed by several authors in preference to the Caldwell-Luc technic.

124. von Eicken, C.: Hypernephrom im Siebbeingebiet, Ztschr. f. Laryng., Rhin., Otol. **25**:52, 1934.

125. Kooper, K. G.: Plasmocytoma and Rhabdomyoma of the Paranasal Sinuses, Arch. Otolaryng. **20**:329 (Sept.) 1934.

Eckert-Möbius [126] performed 135 operations in 115 cases with only 3 failures: One was in a case of atrophic rhinitis and 2 were in cases of extensive polyposis. His indications are as follows: (1) in all acute infections (except those due to dental origin) that fail to yield to irrigation or in which there are symptoms of stasis or in which the infection is unusually severe, and (2) in uncomplicated chronic cases in which extensive polyposis is ruled out. Even the latter in many instances yield to the window operation. When roentgenograms reveal marked polyposis in chronic cases of catarrah he advises the Caldwell-Luc operation.

The postoperative care lasted ten days on the average in the acute cases and twelve days in the chronic. Later examination revealed an opening in the inferior meatus varying from 0.5 to 1 cm. in diameter. He prefers this operation because of its simplicity: It does not incapacitate the patient and does not affect the sensation of the face and teeth.

In the discussion that follows, Zange expresses the opinion that the operation is not indicated in acute cases and states that the author's indications were a bit too broad. Meyer also states that acute cases do not require surgical intervention unless osteomyelitis is present, in which event a more radical operation is needed. In chronic cases in which conservative treatment fails he believes that the antral mucosa should be removed and therefore prefers the Caldwell-Luc technic. Runge stated that he had seen 2 cases of carcinoma of the antrum overlooked because of the intranasal operation. Voss mentioned having cured some of his patients with a chronic condition with short wave irradiation. Blomke supported the views of the author who in closing pointed out that the intranasal operation if properly performed affords a view of much of the interior and permits removal of considerable of its contents. He maintains that too many operations according to the Caldwell-Luc technic are performed in cases in which cure could be achieved by simpler methods.

Goodyear [127] performed 84 intranasal operations on the antrum in six years and finds it important to extend the opening posteriorly for dependent drainage. He elevates the inferior turbinate and makes a large window in the naso-antral wall well down to the floor, using an anterior biting forceps on a universal handle to cut upward, downward and forward as far as possible and a straight downward-cutting sphenoid forceps to cut backward. After curetting all he can reach he packs the

126. Eckert-Möbius, A.: Zur Behandlung der Kieferhöhleneiterungen, Ztschr. f. Hals-, Nasen- u. Ohrenh. **36**:303, 1934.

127. Goodyear, H. M.: Chronic Antrum Infection: Treatment by Intranasal Antrum Operation and Packing, Arch. Otolaryng. **20**:542 (Oct.) 1934.

cavity with 5 per cent iodoform gauze, filling the opening completely. This is left in place for from four to nine days, a procedure which the author believes essential to success. Postoperatively few irrigations are used, but silver nitrate is frequently applied to the opening. Goodyear's postoperative roentgenograms show the antrum to be of full size, as against the reduction in size which follows operation by the Caldwell-Luc technic. He mentions the fact that in 6 of his cases secondary enlargement of the opening was necessary.

Schuster and Decker [128] advise the injection of a 2 per cent solution of procaine hydrochloride into the infra-orbital foramen directly through the cheek. They describe the anatomy and the technic. The needle is inserted to a depth of from 0.6 to 1.2 cm., and the point is directed slightly outward. They advise using a flexible needle, by which resistance is more easily felt. If resistance is suddenly lost it may mean that the needle has entered the orbit. The authors use this technic in conjunction with the local application of cocaine in the nose, and claim that excellent anesthesia is obtained.

The sensory disturbances following operation on the antrums are fully discussed by Strong.[129] He injected iodized poppy-seed oil 40 per cent into sockets of teeth of specimens and showed a communication between the individual sockets, the oil traveling along the alveolar region. He also made sections through the anterior antral wall and floor and sections through devitalized teeth and made injections into the carotid artery in a number of specimens. In addition, he made clinical examinations on 32 patients postoperatively by transillumination, percussion, roentgenograms and chemical and thermal stimulation and proved the following important points:

1. The arteries of the teeth are not terminal vessels. There is an anastomosing plexus of vessels along the upper border of the alveolus beneath the antral floor and in the lateral antral wall; a portion of this bone contains a vascular plexus.

2. By making an injection into the socket of one tooth it is possible to introduce the material into the canals subservient to several adjacent teeth.

3. The canals to the central and lateral incisors run on the anterior wall of the superior maxilla.

4. The infra-orbital artery gives off a series of descending vessels in an irregular and stellate manner.

---

128. Schuster, B. H., and Decker, W. C.: Local Anesthesia in Radical Operations on the Maxillary Sinus, Arch. Otolaryng. **20**:67 (July) 1934.

129. Strong, C.: The Innervation and Vascular Supply of the Antrum, J. Laryng. & Otol. **49**:400 (June) 1934.

5. The dental canals become hemicanals in the upper part of their course, forming grooves in the lateral antral wall. Vessels occupying these canals furnish nutrition both to the teeth and to the mucosa of the antrum. They form an antrodental plexus.

6. The nerves to the teeth do not anastamose as do the vessels.

Examination of patients from four days to three years after operation revealed a certain number to have anesthetic teeth, usually the first and second premolars and the first molar. Despite anesthesia these teeth showed no signs of loss of vitality, retaining normal color, firmness and viability as shown by cross-section of the pulp in purposely extracted teeth. Such teeth are no more liable to infection than normal teeth. The author concludes that the Caldwell-Luc operation denervates from one to three teeth but in no way affects their vitality.

Lautenschläger [130] describes the formation of the alveolar pocket, which is so frequently incompletely cleaned out in the radical operation. He believes that when the danger of leaving diseased tissue is great enough the surgeon is warranted in cutting off the roots of projecting teeth in order to level the floor of the cavity thoroughly and remove all infected tissue. The author does not hesitate to remove the ascending palatine process with its tooth roots if necessary to clean out the antrum completely. He has seen cases in which subsequent to this operation new bone formation has anchored loose teeth and made them permanently useful to the patient. The author claims that teeth projecting free into the antrum are really foreign bodies and that the most one can expect is slow absorption. Such teeth when cut off usually heal over with new bone. Contrary to the opinion of dentists the removal of healthy pulp is not dangerous to the tooth, and the tooth does not undergo cystic or granulomatous degeneration. Only diseased or carious teeth should be extracted. The author concludes with the emphatic statement that radical operation for the removal of diseased tissue requires the sacrifice of dental roots if they are in the way.

Shapiro and his associates [131] performed a bilateral operation according to the technic of Caldwell and Luc on 17 patients, using the vertical incision on one side and the horizontal on the other. It was found that there was no difference from the standpoint of sensory disturbances in the effects of the two incisions, although the authors believe that the vertical has some technical advantages. All the patients complained of tenderness and paresthesia within four weeks following operation.

---

130. Lautenschläger, A.: Oberkieferhöhle und Zahnsystem, Chirurg **6**:335 (May) 1934.

131. Shapiro, S.; Fabricant, N. D., and Stephan, R. M.: Sensory Disturbances Following Radical Operations on the Antrum with Evaluation of the Vertical Incision, Arch. Otolaryng. **19**:303 (March) 1934.

There was no anesthesia of the cheek. Eight of 10 patients seen one year after operation complained of abnormal sensations ranging from hypo-esthesia to hyperesthesia. Four subsequently had upper teeth extracted. Only 1 of 6 who had dental tests showed any abnormality, with but one tooth affected in this case.

Some of the postoperative complications and sequelae of the radical operation on the antrum are discussed by Tokunaga,[132] Rudakow [133] and Ishii.[134] Tokunaga reports the development of a cyst in the cheek nine years following a radical operation on the antrum in a man of 39. It developed with tenderness, swelling of the cheek and bloody nasal discharge. Preliminary puncture revealed a dark green, thin, sterile fluid containing cholesterol crystals and fat bodies. The cyst was removed sublabially and was found in the scar tissue, as described by Kubo, communicating with the antral cavity by way of a small fistula. In Ishii's case two days following the removal of the packing after an operation according to the technic of Caldwell and Luc there were several severe hemorrhages requiring further packing for their control. Otitis media suppurativa developed simultaneously with a swelling of the cheek. An abscess developed which was later incised. There was no communication between the abscess cavity and the antrum. The author ascribes the streptococcic local infection to the traumatism of repeated packing. Rudakow claims that most complications of the radical operation on the antrum are due to (1) the local anesthesia, (2) the horizontal incision, (3) extensive removal of the facial wall, (4) removal of the mucosa from the antrum and (5) primary suture. Also, traumatism to the soft tissues plays a part. The author therefore prefers the intranasal operation and the vertical incision. He believes that the latter is useful even for diagnosis and decision as to how much surgical intervention is required in a given case.

On the Frontal Sinuses.—Bajkay [135] presents a résumé of the operative procedures on the frontal sinus in vogue at the rhinologic clinic of the University of Budapest. In general, the indications for surgical intervention are in line with those accepted in this country. Patients with acute infection are treated conservatively: in some instances drainage is assisted by means of minor intranasal surgical

132. Tokunaga: Zur Kasuistik der post-operativen Wangencyste, Otologia, Fukuoka **7**:855, 1934.

133. Rudakow, W. O.: Zur Frage der Wahl der operativen Methoden bei der Behandlung der Kieferhöhlenentzündungen, Ž ušn. Bol. **11**:289, 1934; abstr., Zentralbl. f. Hals-, Nasen- u. Ohrenh. **23**:499 (Nov. 10) 1934.

134. Ishii, T.: Wangenabscess nach Radicaloperation der Kieferhöhle, Otologia, Fukuoka **7**:505, 1934.

135. v. Bajkay, T.: Beiträge zur Chirurgie der Stirnhöhle, Monatschr. f. Ohrenh. **68**:1341 (Nov.) 1934.

procedures to free the nasofrontal duct. When threatening symptoms are present simple external trephine is resorted to. Eight such cases are reported, in 3 of which it was necessary to resect the operculum and the nasal septum. All the patients recovered promptly. In the presence of orbital or intracranial symptoms, such as continuous headache, edema of the lids, chemosis, exophthalmic chills, vomiting, enlarged spleen, the Kernig sign, stiff neck or somnolence, the sinus is opened externally for radical exposure. In the treatment of chronic frontal sinusitis there is an inclination to be conservative up to a certain point except for thorough cleaning up of a coexistent infection of the antrum. That is, irrigation is employed for a period of weeks or months, depending on the symptoms. Should such measures prove fruitless surgical intervention is then considered. In such cases the members of the staff are inclined to adopt a procedure that disregards cosmetic results. When it is desirable to maintain the cavity the author advises a flap of mucosa according to the method of Bárány, Halle, Marschik or Uffenorde. The author agrees that a radical operation should include complete removal of the entire mucous lining. In the presence of a complicating orbital infection the author advises opening the sinus first and then proceeding according to the location and extent of the orbital abscess. In minor cases drainage is effected intranasally. In others the external approach has been employed, and in a few cases the Krönlein technic has been followed. Osteomyelitis is treated early and radically. The author believes that one must not wait for fluctuation but operate as soon as there is local tenderness or swelling. He reports 4 cases of mucocele, in 3 of which the patients were cured by external operation and in the fourth the patient was treated conservatively by an intranasal method on account of his poor general condition. In cases of fracture of the frontal sinus, if there is any evidence of splintering of bone, external wounds or injury to the internal wall or brain, one must open widely and treat along general surgical principles.

Kleinfeld [136] found it necessary to perform a complete Riedel operation on a man of 55 who had previously been subjected to several intranasal operations as well as to an operation according to the Killian technic but had had recurrences and threatening symptoms of involvement of the brain. A cure resulted, and after nine months the deformity seemed less marked than originally.

Stupka [137] used celluloid to fill in a depression following an external operation on the frontal sinus where there was no direct connection with the nasal cavity, and obtained a satisfactory cosmetic result.

---

136. Kleinfeld, L.: Frontal Sinus: "Collapse" Operation, J. Mt. Sinai Hosp. **1**:13 (May-June) 1934.

137. Stupka, W.: Alloplastic celluloid Prothese zur kosmetischen Verbesserung der Stirngegend nach entstellenden äusseren Stirnhöhlenoperationen, Arch. f. Ohrenh.-, Nasen- u. Kehlkopfh. **138**:79, 1934.

On the Ethmoid and Sphenoid Sinuses.—Smith [138] makes a plea that the term "radical" be changed to "complete" when that type of surgical intervention is designated. He states that anatomically it is impossible to remove completely every vestige of disease of the sinuses and that the attempt is fraught with greater danger when the intranasal route is employed. The external route is indicated in those cases in which the condition has "resisted intelligently applied intranasal treatment." Smith's method of external approach to the frontoethmosphenoid group of sinuses is described in detail. The advantages claimed for this procedure are safety, direct view of the field, complete evisceration of diseased tissue, no pain, only slight bleeding and mild postoperative reaction.

Monson [139] describes a new intranasal technic for operation on the ethmoid sinuses in which a preliminary submucous resection of the middle turbinate preserves the turbinal mucosa. This is later reflected on the lateral nasal walls after the ethmoid cells have been eviscerated and is held in place by light packing for from twenty-four to forty-eight hours. The author has performed the operation in 59 cases with no untoward results. The advantages claimed for this operation are greater safety during the procedure, preservation of the sense of smell and a minimum of postoperative crusting.

Warren and Griffith [140] recommend external spheno-ethmoidectomy in cases of sphenopalatine neuralgia, bronchiectasis and asthma in cases in which allergy has been ruled out. They have also had a cure in a few cases of osteo-arthritis, neuritis and iridocyclitis. Their technic is similar to that now generally employed except that they do not tie off the posterior ethmoid artery and use a rubber tube leading into the nose for drainage. Nonspecific protein therapy is administered postoperatively for several days. They approve of Ferris Smith's idea of stripping the mucosa from the walls of the sinuses with a trinitrophenol-acetone swab.

Sewall [141] has found a weakness in the external operation in that adequate drainage of the frontal sinus is often blocked by the soft tissues being drawn to the medial side through lack of bony support and blocking of the nasofrontal opening. To correct this he describes the following technic:

138. Smith, F.: Management of Chronic Sinus Disease, Arch. Otolaryng. **19**:157 (Feb.) 1934.

139. Monson, L.: A New Intranasal Operation on the Ethmoid Sinus, Arch. Otolaryng. **19**:40 (Jan.) 1934.

140. Warren, E. D., and Griffith, G. E.: External Ethmoidectomy, Laryngoscope **44**:128 (Feb.) 1934.

141. Sewall, E. C.: External Fronto-Ethmo-Sphenoid Operation: New Mucosal Flap for Controlling Drainage and Granulation Tissue, Arch. Otolaryng. **20**:57 (July) 1934.

After the frontal sinus, ethmoids and sphenoid have been attended to, the nasal mucosa is separated from the lateral wall of the nose. This is easily accomplished by passing a spatula down inside the exposed bony edge. . . . The spatula passes down on the nasal wall of the maxillary bone, and the mucous membrane is separated down to, or even onto, the inferior turbinal. The raised mucosa can be determined by looking into the nose through a speculum, and the position of the underlying spatula is seen as it is moved from above; a long sharp knife is introduced into the nose and a horizontal cut is made through the mucosa to the underlying spatula. This fashions the lower end of the flap. The anterior and posterior cuts are then made.

These incisions may be completed through the external opening. The flap is raised or pulled up. Attached at its upper end, it is plastered over as much of the frontal sinus as it will cover. The flap measures on the average from 4 to 7 mm. in length, from 2 to 3 cm. in width at the bottom and from 1 to 2 cm. at the top. An additional flap is described which is taken from the median wall of the ethmoid mass, including the ethmoid turbinals, which is reflected laterally and upward to cover the denuded under-surface of the frontal bone adjacent and lateral to the cribriform plate. The author suggests the removal of the floor of the sphenoid sinus to prevent closure by granulations, but he points to the danger of an anomalous vidian nerve lying free in the sinus. Such a procedure is to be carried out only when the floor of the sinus is badly diseased. Otherwise mere drainage is sufficient. One can thus avoid tying the sphenopalatine artery.

Hill [142] followed up 18 cases in which an operation in the ethmo-sphenoid area had been performed with removal of the spheno-ethmoid partition and establishment of a large opening. In 8 of these it was necessary to reopen the sphenoid sinus one or more times. The fault cannot be ascribed to the surgeon, as similar results have been reported by many. The author had used silver nitrate, tri-chloracetic acid, electro-coagulation and roentgen rays in an effort to maintain the opening, without avail. He quotes Goldsmith that "if a cavity which was not intended by Nature to have a large inlet or outlet is widely opened, the mucous membrane will resent it." Hill has found that contracture of the opening does not leave the patient any worse off than the patient in whom a large opening remains. In fact, he is more comfortable in cold weather. In such a case the cavity has to be reopened only when reinfection occurs, which is the exception and not the rule. The external operation is preferred, particularly when the sphenoid sinus is shallow or the infection is the basis for allergic symptoms.

142. Hill, F. T.: Post-Operative Observations upon the Sphenoidal Sinus Following Ethmo-Sphenoid Operation, Tr. Am. Laryng., Rhin. & Otol. Soc., 1934, p. 151.

Matis [143] again describes his intranasal subperiosteal approach to the frontal, ethmoid and sphenoid sinuses. His idea is to avoid external scars and at the same time provide a wider opening into the fronto-ethmoid region than is possible by other intranasal methods. He claims that his technic is less severe than the external radical method, that all the sinuses can be cleaned out through the one incision, and that the view of the operative field is broader than that in any other intranasal operation. The incision is made within the vestibule opposite the pyriform margin; soft tissues externally are separated by subperiosteal elevation, and the frontal process of the superior maxilla is resected. A broad approach is afforded to the frontal sinus by the removal of its floor above the lacrimal fossa. To approach the ethmoid cells it is necessary to remove the lacrimal bone. After the cells are eviscerated one can easily remove the anterior wall of the sphenoid sinus and clear out its contents. For operations on the antrum the author uses the same approach and combines it with the Sturmann-Canfield technic. He claims for this method that it is accomplished without external scar, without danger of fistula and without postoperative neuralgia. It is more radical, affords a wider view of the sinus than any other intranasal procedure, and avoids wounding healthy overlying periosteum.

General Comment.—Buckley [144] thinks that the ill repute of surgical intervention on the sinuses in many cases is due to a lax interpretation of indications. Too many patients are operated on for relief of asthma or retrobulbar neuritis. He believes that the sinuses must be proved definitely to be diseased before surgical procedure is advised. Certain details of technic for the antrum window and the Caldwell-Luc method are emphasized, having to do chiefly with the size and permanence of the naso-antral opening. Hemorrhage and the danger of meningitis, he claims, often defeat the operation on the ethmosphenoid area. In work on the sphenoid sinus it is better to stay near the septum, thus avoiding the sphenopalatine artery.

Lewis [145] states that destruction or removal of sinus mucosa is bad surgical technic. "Diseased mucous lining is preferable to exposed bone, for diseased as it may be the lining membrane seems capable of standing between a pus-filled sinus and endogenous infection." His attitude toward radical operation is pessimistic. He scouts the theory of focal infection and has found reinfection and relapses common in his experi-

143. Matis, E.: Die subperiostale, vestibulo-nasale Operationsmethode, ein neues operatives Verfahren der Nasennebenhöhlen, Monatschr. f. Ohrenh. **68**:307 and 427, 1934.

144. Buckley, R. E.: How to Obviate Failures in the Results of Paranasal Sinus Surgery, Laryngoscope **44**:853 (Nov.) 1934.

145. Lewis, W. W.: Disillusionments in Nasal Surgery, Minnesota Med. **17**: 323 (June) 1934.

ence. Simple drainage is as much as he will permit in the vast majority of cases of frontal, ethmoid and maxillary infection. The only indications for the Caldwell-Luc operation which he will concede are foreign bodies, cysts or tumors.

NONSURGICAL THERAPY

Grove [146] points out the necessity of preserving ciliary activity and not destroying the normal mucin blanket by the use of drugs and irrigation. He seeks to aid natural drainage and ventilation and advises proper diet, sunshine and change of climate. He also refers to Jarvis' work on the effects of lack of fat in the diet of the young and lack of uncooked vegetables in young adults as predisposing factors in the production of catarrhal discharge. Avitaminosis is important in the etiology. Vaccines and nonspecific proteins are recommended in certain cases. The frequent association with allergy must always be borne in mind, and all possible irritants should be traced and eliminated.

Roentgen therapy in cases of chronic sinusitis was thoroughly tried out by Butler and Woolley.[147] They refer to a previous report of 100 cases published by them in 1932 in which 31 per cent of the patients were symptom-free, 50 per cent, definitely improved, and 19 per cent, unchanged. They have seen no deleterious effects on nerve tissue, skin, tooth buds or vessels. Experimentally they infected the sinuses in twelve cats and then treated them with roentgen rays. Examination of the mucosa removed twenty-four, forty-eight and seventy-two hours later showed early breaking down of lymphocytes with a later increase of macrophages. The membranes were reduced in thickness but retained numerous plasma cells, polymorphonuclears and some histiocytes. After a few weeks fibrosis appeared. There was no evidence of injury to the ciliated epithelium or other cellular elements. Clinically they report 700 cases in which treatment was by roentgen irradiation. These cases were divided into five groups, practically all subacute or chronic. The average dose was 800 roentgens (120 kilovolts, 5 milliamperes) at a target distance of 11 inches (27.9 cm.) and ten minute exposures through a 1½ inch (3.7 cm.) portal filtered with a 4 mm. aluminum screen. The dose was applied over each group of cells separately, but all involved areas were treated on the same day. The central ray was directed so as to produce a cross-fire of the posterior ethmoid sinuses and the sphenoid sinus. In 36 per cent of the cases the condition was entirely relieved, in 55 per cent there was definite improvement, and

146. Grove, W. E.: Conservative Treatment of Nose and Accessory Sinuses, Ann. Otol., Rhin. & Laryng. **43**:988 (Dec.) 1934.

147. Butler, F. E., and Woolley, I. M.: Roentgen Therapy in Chronic Sinusitis, Radiology **23**:528 (Nov.) 1934.

in 9 per cent there was only slight improvement or no benefit. In the discussion which follows Fenton states that while the results were good it does not mean that recurrences may not take place. Also, the treatment will not be effective if the infection is due to carious teeth or if allergic phenomena cause blockage of drainage from the ethmoid sinuses. Patients with multiple abscesses in the mucosa with streptococcic infection improve temporarily under roentgen therapy but will certainly have recurrences requiring surgical intervention. Fenton believes that roentgen therapy is most effective in cases of simple round cell hyperplasia.

Kisch and Salmond [148] used roentgen rays for relief of pain following operations on the sinuses, and obtained prompt palliative relief in 7 patients thus treated. Two of the 7 were completely and permanently relieved; the others showed a tendency to recurrence. The treatments were given at weekly intervals at first and then less frequently. From four to thirteen treatments were administered in the various cases. The dosage amounted to ¼ to ¾ Sabouraud pastille, with a spark gap of 9 inches (22.8 cm.) filtered with from 3 to 4 mm. of aluminum at an anticathode distance of 30 cm.

Cox [149] reports the cases of 19 patients with infection of the sinuses, nasal allergy and associated asthma of the bronchial type treated with specially prepared autogenous vaccines. He obtained a cure in 78.9 per cent. All the patients were tested for reaction to various proteins in order to rule out specific allergic disease. Each patient was then tested intradermally by the injection of 0.05 cc. of various emulsions made from a variety of bacteria to determine their sensitivity, the reactions being watched up to twenty-four hours. A wheal or a red tender area 1.5 cm. in diameter was considered a positive reaction. The same amount of sterile broth was injected as a control. Each bacterial emulsion contained 500,000,000 bacteria per cubic centimeter so that the test dose amounted to 25,000,000 organisms. A combined vaccine containing the various bacteria to which the patient reacted was then prepared for treatment, as follows:

> Individual bacterial emulsions standardized at 1,000,000,000 using as a diluent sterile broth filtrate diluted with two parts of an 0.4% pheno-saline solution. Equal parts of each of the standardized emulsions were mixed in a 50 ml. sterile vaccine bottle kept at room temperature for 24 hrs., during which period an occasional shaking was given and then tested aerobically and anaerobically for sterility.

148. Kisch, H., and Salmond, R. W. A.: Treatment of Postoperative Pain in Chronic Sinusitis by X-Rays, J. Laryng. & Otol. **49**:464 (July) 1934.

149. Cox, W. C.: Autogenous Vaccines in the Treatment of Chronic Sinus Infections and Nasal Allergy (Further Studies), Mil. Surgeon **75**:317 (Nov.) 1934.

Injections were given every fourth day starting with 0.025 cc. intradermally and increasing 0.025 cc. at each injection until 0.3 cc. was given. The increase following that was 0.5 cc. at each dose given subcutaneously until a maximum of 1 cc. was reached. This dose was continued until benefit or failure was established. Vaccines causing marked local or general reactions were diluted with physiologic solution of sodium chloride containing 0.25 per cent phenol for further administration.

Kracaw [150] also obtained good results from the use of autogenous vaccines in 45 cases of disease of the sinuses. He claims satisfactory end-results in 95 per cent. He used a vaccine prepared according to the method of Krueger,[151] the essential features being "the exclusion of metabolites by means of thorough washing of the cells before maceration, avoidance of alterations in the cellular antigens by exclusion of heat or chemical treatment, the removal of viable bacterial cells with the ultra-filters and the standardization of the solutions on the basis of nitrogen content." He used the lysate locally at the same time that the antigen was administered. The injections were given intradermally up to a certain point and then continued hypodermically.

Arslanian and Valette [152] used the Proetz method in 15 cases with good results. They instilled 2 cm. of iodized poppy-seed oil 40 per cent, strong silver protein or mild silver protein, followed by suction at a negative pressure of from 240 to 250 mm. of mercury. Treatments were given every four to five days. It was found especially effective in children.

Kramm [153] employed a 1 : 5 dilution of calcium hydroxide in distilled water as an irrigating solution in cases of chronic suppurative frontal sinusitis. He bases his optimistic results on the action of the calcium hydroxide in dissolving thick mucoid secretion and its drying and bactericidal effects. He quotes Meyer and Gottlieb to the effect that calcium hydroxide unites with fatty acids, which it saponifies, and thus condenses the lipoid constituents and cement substances of the tissues. He assumes that the calcium salts also exert a resorbing influence on the vegetative nervous system, lessening its irritability and

150. Kracaw, F. C.: Chronic Sinus Infection: A New Method for Its Treatment, California & West. Med. **40**:228 (April) 1934.

151. Krueger, A. P.: Method for Preparation of Bacterial Antigens, J. Infect. Dis. **53**:237, 1933. Krueger, A. P.; Nichols, V. C., and Frawley, S. M.: Preparation of Active Undenatured Antigen from Hemophilus Pertussis, Proc. Soc. Exper. Biol. & Med. **30**:1097, 1933.

152. Arslanian, N., and Valette, M.: Traitement des sinusites par la méthode de déplacement, Rev. de laryng. **55**:862, 1934.

153. Kramm, H.: Die Behandlung der chronischen Stirnhöhleneiterung mit Kalkwasser, Ztschr. f. Hals-, Nasen- u. Ohrenh. **35**:536, 1934.

causing a constricting effect on the capillaries, thus resulting in a definite restriction of the inflammatory process. He also cites experimental works to prove that calcium hydroxide is bactericidal.

Van Alyea [154] presents a rather complete historical review of therapy of the frontal sinuses for the past fifty years. The trend has varied from the ultraconservative to the extreme radical procedures. He points out the anatomic variability of the nasofrontal duct from a narrow tortuous passage hidden away in the anterior ethmoid labyrinth to a wide ostium opening directly into the anterosuperior portion of the middle meatus. The natural ostium is reached by way of the frontal recess in from 55 to 60 per cent of all cases, by way of the ethmoid infundibulum in from 12 to 16 per cent and through the hiatus semilunaris in from 25 to 35 per cent; and the duct is suprabulbar in from 1 to 3 per cent. The author cites 9 cases of acute and chronic frontal sinusitis in which the symptoms were relieved by irrigation. Two cannulas (author's modification) are described of smaller lumen and longer shaft than usual, with double curves, one having its outer curve at 90 degrees to the main shaft and the other at 120 degrees with the tip.

Various procedures in physical therapy for the relief of sinusitis are discussed by Follweiler.[155] He recommends the application of luminous heat or infra-red rays to the entire face for from twenty to thirty minutes every three hours in acute conditions and claims that these measures relieve the pain and sense of fulness and promote drainage. If diathermy is used in such conditions it may increase the pain unless the sinus has been previously drained. The author does not have much to say with regard to the efficacy of diathermy and the quartz mercury vapor lamp in chronic cases except as aids to recovery following operation. He recommends zinc ionization to promote healing after operations on the frontal or sphenoid sinuses or on the antrum. In general, the author is conservative in his claims for physical therapy: he believes that the prime essentials are ventilation and drainage and that physical measures are useful adjuncts to recovery.

Reed [156] found in a series of 50 cases in which there was severe pain from an infection of the sinus that a preparation of amidopyrine containing the magnesium radical was much more effective than amidopyrine, U. S. P. Patients required the medication less often and got more prompt relief. He refers to the work of Gwathmy, Barber and others on the subject of magnesium synergism.

---

154. Van Alyea, O.: Irrigation in the Treatment of Disease of the Frontal Sinus: Anatomic and Clinical Study of the Nasofrontal Connections, Arch. Otolaryng. **19**:224 (Feb.) 1934.

155. Follweiler, F. L.: Physical Therapy in Nasal Accessory Sinus Disease, Arch. Phys. Therapy **15**:222 (April) 1934.

156. Reed, W. C.: The Relief of Pain in Sinusitis, J. Indiana M. A. **27**:508 (Nov.) 1934.

GENERAL CLINICAL OBSERVATIONS

Vail [157] presents an interesting analysis of the factors involved in the production of pains in the head from sphenoiditis. He says that a "summary of the known facts shows that from embryological, anatomical and clinical viewpoints there are sufficient nervous pathways to completely explain the reflex pain in sphenoiditis without needing to call upon a system of afferent fibers in the sympathetic nervous system." The path of pain in the eye and orbit is by way of the vidian nerve and the sphenopalatine ganglion through its orbital branches to their anastamoses with terminal branches of the ophthalmic division and up the ophthalmic division to the gasserian ganglion to the brain. The path of pain in the ear is along afferent sensory fibers of the great superficial petrosal nerve to the geniculate ganglion. From the latter the stimuli pass along the geniculotympanic branch to the tympanic plexus and back by way of the glossopharyngeal nerve to the medulla and from there to the cortical center. Another arc is from the great superficial petrosal nerve to the geniculate ganglion and up the intermediary nerve to the medulla, where by means of the descending root of the fifth nerve contact is established with the ninth and tenth nerves. The same mechanism would explain pain in the back of the head and overflow to the cervical sensory nerves of the arm and shoulder. The author concedes with Davis and Pollock the possibility of production of pain by way of the sympathetic pathways—postganglionic efferent fibers to the structures innervated by the sympathetic fibers, the stimulation of which acts on the skin and other structure in an unknown way. Yet in most cases, as stated earlier, referred pain can be better explained by the routes mentioned.

Roes [158] reports 4 cases in which typical trigeminal neuralgia (2 with tic) accompanied chronic maxillary sinusitis. The attacks were usually brought on by acute exacerbation of the sinusitis, which in the first place was usually due to influenza. In the absence of histologic studies of the nerves themselves the author assumes that the pains were induced by involvement of the nerve endings in the inflammatory process with pressure of the fluid secretions as a secondary factor. The pains were usually most severe in the distribution of the supraorbital branch, despite which the frontal sinus was found in no way involved.

Bouvy and Flynn [159] present a consideration of the etiologic factors in disease of the sinuses. Heredity comes first. The authors express

157. Vail, H. H.: Diseases of the Sphenoid Sinus as Cause of Reflex Pain in the Head, Tr. Am. Laryng., Rhin. & Otol. Soc., 1934, p. 294.

158. Roes, F.: Trigeminusneuralgie bei chronischer Kieferhöhlenentzündung. Internat. Zentralbl. f. Ohrenh. **38**:249 (July) 1934.

159. Bouvy, H. M., and Flynn, J. B.: Etiologic Factors in Disease of the Nasal Accessory Sinuses, Northwest Med. **33**:84 (March) 1934.

the opinion that the tendency to disease of the sinuses may be transmitted. Failure of infantile sinuses to clear of fluid and become aerated may lead to repeated infections. Development of the sinuses may also be arrested. Anatomic malformation is also of etiologic importance. High septal deviations blocking the normal ostia predispose to retention and impair ventilation. The frontal or maxillary sinuses may also be blocked by pneumatized or hyperplastic middle turbinals and large or misplaced uncinate, infundibular or bullar cells. An unusual situation of the maxillary ostium or hypertrophy has a tendency to close the maxillary ostium. Infected tonsils and adenoids, especially in children, impair ventilation and drainage and may interfere with ciliary activity. Climate that is changeable as to temperature and humidity predisposes one to infection of the sinus. Diet is important. When the diet is deficient in vitamins the resistance to infection is lowered. In the treatment of infection of the sinuses diet may be of great assistance. Allergy may figure as a cause of infection also through lowered resistance, and the same statement applies to a low thyroid metabolism. Among the other factors mentioned by the authors as predisposing to infections of the sinuses are a hypersensitive nervous system, mental strain, hard work, gastro-intestinal disorders, impaired ciliary activity from sudden drying and changes in temperature and humidity.

Forster [160] presents an unusual case occurring in a dentist in whom a thrombosis of the axillary vein developed complicating acute maxillary sinusitis. The patient had suffered four attacks of tonsillitis previously, the last attack having occurred ten weeks before the disturbance in the arm. Acute rhinitis lasting five days preceded the present complaint. Pus was seen below the middle turbinate, the antrum was dark on transillumination, and exploratory puncture revealed much pus. An opening was drilled through the inferior meatus into the antrum, and for four days there was improvement. The arm became acutely swollen, tender and improved very slowly. Four months later there was still some evidence of dilated veins on the chest. Eventually the arm and hand returned to normal size. The author cites similar cases previously reported.

---

160. Forster, H. V.: Thrombosis of Axillary Vein Associated with Chronic Empyema of the Maxillary Sinus, J. Laryng. & Otol. **49**:178 (March) 1934.

Correspondence

THE RIGHT ANGLE INCISION IN THE RADICAL (CALDWELL-LUC) ANTRUM OPERATION

To the Editor:—In the May issue of the ARCHIVES OF OTOLARYNGOLOGY (**21**: 608, 1935), Dr. H. P. Merrill of Los Angeles criticizes an earlier article of mine, which appeared in the February number of the same journal (**21**:206, 1935), entitled "The Right Angle Incision in the Radical (Caldwell-Luc) Antrum Operation."

I can assure Dr. Merrill that I have been thoroughly conversant with the enervation of the teeth for a number of years, and I insist that there is nothing

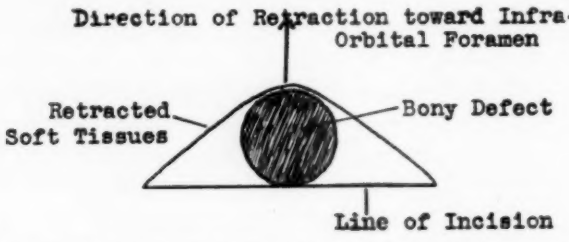


Fig.1.—The classic transverse incision for the Caldwell-Luc operation, with the soft tissues retracted sufficiently to make a bony defect.

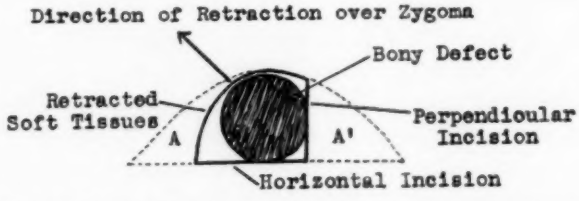


Fig. 2.—The right angle incision for the Caldwell-Luc operation, with the soft tissues retracted and an opening made into the antrum. The transverse incision with the necessary retraction is indicated by the dotted lines. *A* and *A'* indicate the areas of bone exposed by the transverse incision which are not exposed by the right angle incision.

in the aforementioned article that could be construed as indicating otherwise. In rereading my paper I have not been able to find any mention of the statement, which Dr. Merrill seems to have found, that the infra-orbital nerves supply the upper teeth.

The main point of controversy seems to hinge around the use of the term "dental." Undoubtedly originally it referred to the teeth only. Since modern dentistry is concerned not only with the teeth but with the gums and alveolar processes, the use of the adjective (dental) has expanded to include these structures.

Dr. Merrill asserts that when a transverse incision is used it is easier to expose the bone and make a large bony defect. It has been my experience that the exposure of bone is easier when the right angle incision is used and that a bony defect of any size can be made as easily as with the older type of cut. Before submitting my paper for publication I used this new type of incision many times and compared the results very carefully with an earlier series of cases in which the old horizontal incision was used. Figures 1 and 2 illustrate the two types.

A flap is formed by my incision, and when this is lifted upward and laterally at least half the bone to be removed is exposed without stretching the soft tissues. Only a moderate amount of further retraction is necessary to complete the exposure. I think that a definite additional advantage is gained when the retraction is directed over the zygoma, as with the right angle incision, instead of directly upward in the direction of the infra-orbital foramen, as with the old classic transverse incision.

Most of the unpleasant sequelae of the radical operation on the antrum are concerned with the approach to the antrum through the anterior wall of the maxilla. If the right angle incision or any other incision will reduce these sequelae, it should be tried and judged on its merits and not condemned by some one because a different interpretation is read into the use of a descriptive adjective than was justified or intended.

L. P. Monson, M.D., San Francisco.

Abstracts from Current Literature

Ear

TUBERCULOUS DISEASE OF THE MIDDLE EAR AND MASTOID. H. ROSS SOUPER, Edinburgh M. J. **41**:154 (March) 1934.

This disease is rare in adults but not so rare in children. Thirty-six cases are reported for a period of eleven years in the Royal Aberdeen Hospital for Sick Children. In 50 per cent of the children under 1 year of age the suppurative otitis media was tuberculous, the incidence being more probable the younger the child, as was found in the Edinburgh survey.

Otitis of this origin begins insidiously and painlessly, the discharge being the usual sign to call attention to the ear. Swelling of the mastoid or facial paralysis brings the child to the hospital.

The characteristic changes are large perforations and granulations; the discharge, which at first is thin and flaky, becomes purulent, fetid and blood-tinged, occasionally containing bacilli. Osseous involvement is striking, with its frequent complications of facial paralysis. About 50 per cent of Souper's patients showed paralysis, even before operation. Enlarged periauricular glands were noted in 77 per cent of his cases, the condition of the preauricular region being of diagnostic significance.

The author's patients seldom had a personal or family history suggestive of tuberculosis. Not all the children presented an appearance of severe illness. Infection is thought to reach the middle ear by way of tuberculous milk entering the eustachian tube, a percentage of 80 or more of the babies in Scotland being bottle-fed.

The disease is confirmed by finding the bacilli in the discharge, by inoculation of the bacilli into laboratory animals or, most commonly, by typical histopathologic osseous tissue taken at operation.

The operation is radical, the mortality being 50 per cent. Most deaths are due to tuberculous meningitis or postoperative shock. The general condition of the child has an important bearing on the diagnosis, even if widespread necrosis of bone is present. Thirteen children were alive from eight months to eight and one-half years after the operation. In seven of these the infection proved to be tuberculous.

NEFF, Kansas City, Mo. [AM. J. DIS. CHILD.]

A CASE OF ENCEPHALITIS FOLLOWED BY DEAFNESS. S. GRACOSKI, Bull. Soc. de pédiat. de Iasi **5**:3 (Jan.-March) 1934.

An infant, 14 months old, began to have convulsions after five days of fever, diarrhea and vomiting and lay in a stuporous state for several days. Lumbar puncture revealed apparently normal cerebrospinal fluid. Paresis of the right upper eyelid developed. The child's general condition improved greatly, but diminution in vision and hearing persisted.

LEMASTER, Evanston, Ill. [AM. J. DIS. CHILD.]

SEROUS MENINGITIS OF THE CEREBELLOPONTILE ANGLE: OPERATION, FOLLOWED BY DEXTROROTATORY PARALYSIS. H. ROGER, M. ARNAUD and Y. POURSINES, Rev. d'oto-neuro-opht. **12**:123 (Feb.) 1934.

This report concerns a man, aged 30, who awoke with occipital headache accompanied by vomiting, light fever and paresthesia of the right side of the face. Examination revealed hypesthesia of the fifth nerve and slight peripheral paralysis of the facial nerve on the right side accompanied by hemispasm, hypo-acusis on the right side and a syndrome of cerebellar involvement (adiadokokinesis and

hypermetria) of the right hand. A month's sojourn in the hospital ameliorated these symptoms. Six months later the syndrome returned. At that time there existed complete paralysis of the facial nerve, complete deafness of the right ear and vertigo. The right labyrinth was hypo-excitable to rotation; the external rectus muscle was paralyzed. The spinal fluid contained 12 lymphocytes per cubic millimeter and 0.6 Gm. of albumin (with Sicard's instrument); the tension was not increased; the Bordet-Wassermann reaction of the spinal fluid and of the blood was negative. Operation revealed two large arachnoid cysts, one situated behind and to the right of the vermis and the other beside the bulb, and adhesions in the angle. On the second postoperative day complete dextrorotatory paralysis appeared; the head was deviated to the left, and there was intense nystagmus to the left. Improvement occurred, but the patient remained unable to turn the ocular globe to the right beyond the midline. Convergence was possible. This condition is attributed to a new plaque of arachnoiditis compressing the peduncle. Histologic examination of the wall of the cyst revealed only signs of subacute inflammation.

DENNIS, San Diego, Calif. [ARCH. NEUROL. & PSYCHIAT.]

TOPICAL DIAGNOSIS IN OTONEUROLOGY. E. CHARSCHAK, Monatschr. f. Ohrenh. **68**:1324 (Nov.) 1934.

Charschak calls attention to the rapid development of otolaryngology in the last decade and to the fact that this specialty enters into a number of other fields of medicine. As an example he mentions otoneurology, which developed largely on the basis of the methods for examination of the labyrinth. Especial attention is given to the problems of topical diagnosis. On the basis of neurologic principles and otologic methods of examination, an exact diagnosis of a neurologic disorder is frequently possible. It may be said that one can look through the ear into the brain. The author describes several cases that are rather interesting from the point of view of topical diagnosis and describes his manner of using the pointing method. The first patient whose history is described complained of headaches, ataxia and deafness in the left ear. The results of the pointing test and of the calorization test of the ear and the changes observed in the fundus oculi indicated the presence of a tumor at the cerebellopontile angle. The subsequent operation corroborated this diagnosis. The author describes several other cases that were not related as to etiology or symptomatology but were similar in the localization of the process. The author's object is to present the description of a number of otoneurologic examinations of disorders of the different portions of the labyrintho-cerebellar tract. Although in these cases the disorder was located in the posterior cranial fossa, it is known that cerebral disorders likewise may produce otoneurologic manifestations, and the author concludes that examinations of the labyrinth are just as important in neuropathology as are examinations of the fundus oculi.

EDITOR'S ABSTRACT.

FACIAL PARALYSIS AS THE CAUSE OF OBJECTIVE SOUNDS IN THE EAR. B. FIALOVSZKY, Monatschr. f. Ohrenh. **68**:1339 (Nov.) 1934.

According to Fialovszky, it is generally known that various disorders of the ear frequently cause disturbances of the facial nerve, but it is not so well known that facial paresis may cause disorders of the ear. Facial paresis influences the function of the ear (with regard to the cochlear as well as to the vestibular nerve) primarily because the cessation of the innervation of the stapedius muscle excludes the functioning of this muscle. The contraction of the stapedius muscle makes hearing more acute, but it also plays a part in the hearing of the deeper notes. According to Politzer the cutting of the tendon of the stapedius muscle increases the pressure in the labyrinth, which in turn reduces the sensitivity for higher tones and causes tinnitus aurium. It has been observed that in connection with facial paralysis patients are often troubled by abnormal sounds in the ear; that is, they experience what has been ascribed to the spasmodic contraction of the stapedius

muscle. The tensor tympani muscle, which is innervated by the trigeminal nerve, is to a certain extent a synergistic collaborator of the stapedial muscle, but in another respect it is its antagonist. The author describes the history of a man aged 42 who had facial paresis and who occasionally heard popping sounds in his ears. When he was chewing or yawning, the sounds became especially loud. By means of the otoscope, the examining physician was likewise able to hear the sounds (objective ear sounds). After neurologic treatment the facial paresis improved and the objective ear sounds decreased in frequency and intensity. The author attempts the following explanation of this phenomenon: As a result of facial paresis the innervation of the stapedius muscle is interrupted so that the antagonistic action of the tensor tympani muscle predominates. The contraction of this muscle produces the popping sound. The author describes three different types of objective entotic sounds: (1) those caused by the contraction of certain muscles, (2) those which develop in the vessels and (3) those which develop when the eustachian tube is open.

EDITOR'S ABSTRACT.

DISSOCIATION OF CALORIC AND ROTATORY NYSTAGMUS DUE TO DISTURBANCES OF THE VESTIBULAR FUNCTION IN PARKINSONISM. G. E. JANNULIS, Monatschr. f. Ohrenh. **68**:1510 (Dec.) 1934.

Jannulis describes the histories of ten patients with parkinsonism and gives the results of otologic examination. He observed a dissociation between the caloric and the rotatory reaction. The caloric reaction not only was decreased but was frequently absent. In the milder cases of parkinsonism, the caloric reaction was abolished only on one side and, as a rule, on the side contralateral to the severe disturbances of the extremities. In the severe cases the caloric reaction was abolished on both sides. After the patient's general condition improved the caloric reaction reappeared. In one case of dengue even the cochlear nerve was involved. The transplantation of cerebral substance, according to Vlavianos, did not produce a noteworthy effect. The author concludes that the abolishment of the caloric and cochlear reactions can be traced to a change in the chemical nature of the endolymph, just as in an inflammatory process. In cases in which only the vestibular nerve is involved, the impairment may be the result of hydrodynamic reflex action or of the involvement of higher centers located anterior to the decussation at the level of the arcuate fibers. The latter processes disappear more rapidly. It is worthy of attention that the substantia nigra in patients with parkinsonism exhibits a change to which an antitonic influence is ascribed and that here too the pallidofugal fibers are diseased.

EDITOR'S ABSTRACT.

Pharynx

COMPLICATIONS OF RETROPHARYNGEAL ABSCESS. LESTER ROSENBERG and MORRIS BERKE, J. Pediat. **4**:764 (June) 1934.

Retropharyngeal abscess is considered to be a serious condition, requiring fine judgment for proper treatment. The frequent occurrence of sudden death from incision or spontaneous rupture of the abscess is mentioned. The frequency of severe hemorrhage, thrombosis or rupture through the external auditory canal is discussed. Several cases are reported. Fluctuation should preferably be noted before the abscess is incised.

LEMASTER, Evanston, Ill. [AM. J. DIS. CHILD.]

PRECANCEROUS EPITHELIOMATOSIS (BOWEN'S DISEASE) OF THE PALATE AND FAUCES. W. HOWARTH, J. Laryng. & Otol. **50**:28 (Jan.) 1935.

Following a review of the literature on precancerous epitheliomatosis, Howarth summarizes the histologic changes of this disorder as follows: (1) dyskeratosis in a hypertrophic epithelium, (2) preponderance of intracellular over intercellular edema, resulting in the formation of a vacuole about the nucleus, (3) numerous

mitotic figures, (4) clumping of large cells with giant nuclei and large nucleoli, (5) retention of filaments of union and squamous cells to produce hyperkeratosis and parakeratosis and (6) general confused appearance of the malpighian layer. There is no reason why this condition should not occur in the mouth, but no record of a case of its occurrence in this situation has been found in the literature. Examples of its occurrence on the mucous membrane of the mouth, palate and fauces are the three cases which form the basis of this paper, both by reason of the clinical appearance and manifestations and by that of the histologic picture. Howarth gives the histories of the three cases and then shows that microscopically the small portions of tissue removed from the palate suggest that all three are examples of the same condition and that this condition is one which closely resembles the precancerous dermatosis of Bowen. Since certain filtrable viruses affecting human epidermis produce overgrowth of tissue and papillomatous lesions, it was thought worth while to examine the sections from these three tumors for evidence of the activity of a virus. In the sections from one of them undoubted nuclear inclusions were found in the nuclei of many of the tumor cells. The inclusion was a homogeneous or granular acidophilic mass occupying the major portion of the nucleus and separated from the nuclear periphery by a clear halo; there was well marked margination of the chromatin. The inclusion thus possessed the characteristic features of a nuclear inclusion of type A and was similar to those produced by the viruses of such diseases as herpes zoster, varicella and pseudorabies. In attempting to estimate the significance of this finding it has to be borne in mind that, although there is no good evidence that nuclear inclusions of this type can be produced experimentally except by means of a filtrable virus, several workers have recently observed nuclear inclusions in the tissues of man and other animals apart from any manifest disease. If, then, nuclear inclusions are to be accepted as evidence of the presence of a virus, it has to be admitted that viruses may on occasion be present in the tissues of man and other animals without producing disease. From this it follows that the finding of nuclear inclusions in this tumor may have no etiologic significance and may point merely to the chance presence of a virus which as a visitor had taken up its residence in these cells. When one recalls that Levaditi and Nicolau found that actively multiplying tumor cells provide an especially suitable environment for certain viruses, particularly that of vaccinia, and that a considerable percentage of people carry the virus of herpes in their mouths, the fortuitous presence of a virus in a tumor in the mouth is a possibility which cannot readily be overlooked. EDITOR'S ABSTRACT.

LYMPHADENOID TISSUE OF THE UPPER RESPIRATORY TRACT. HENRY VINCENT FORSTER, Lancet **2**:296 (Aug. 11) 1934.

"I find it difficult to agree with the recommendation that when a general anesthetic is given for removal of adenoids the palatine tonsils should also be sacrificed as a matter of routine."

It is not easy to decide how many attacks of tonsillitis a child may be allowed before becoming a subject for tonsillectomy, but it happens that children pass through such phases and then cease to be troubled by further attacks. Reddening of the faucial pillars does not necessarily signify chronic tonsillitis. Edematous infiltration of the tonsil, with associated redness and swelling of the palatal arches, is a definite indication of disease. Glandular enlargement in the tonsillar chain in the neck may be commonly felt; but the diagnosis of harmful enlargement may vary with the personal opinion of the observer, especially when the patient is a child. Conservative treatment is therefore advisable. But when it is noticed that frank glandular enlargement persists, tonsillectomy is indicated, no matter what may be the appearance of the tonsil itself.

The results of adenoidectomy in properly selected cases are often brilliant. It is time, however, to dispel the popular idea that when such an operation gives poor results the adenoid mass has returned and must be removed again. If the operation has been properly carried out, recurrence is rare. The development of

residual granular nasopharyngitis should not call for the curet or the adenectome, but for an inquiry into the general condition of the child and particularly into the condition of the nose.

LANGMANN, New York [AM. J. DIS. CHILD.]

INDICATIONS FOR TONSILLECTOMY. ALFREDO GRUNBERG SMITH, Rev. med. de los hosp. **2**:55 (Feb.) 1934.

To justify tonsillectomy there should be a history of chronic tonsillitis with either local or general symptoms or both. Smith describes these symptoms and the associated pathologic processes.

HERRON, Spokane, Wash. [AM. J. DIS. CHILD.]

TONSILLAR STUDIES ON SYPHILITIC PATIENTS. MITURU KUMASAWA, Hifu-to-Hitsunyo **2**:451 (Oct.) 1934.

Bits of tonsillar tissue of 139 syphilitic patients were removed, macerated and examined under dark-field illumination. Three of the thirteen specimens from patients with primary and eighteen of the twenty-seven from those with secondary syphilis (all the nontreated patients in this group) were positive for Spirochaeta pallida. For patients with the later stages of the disease the results of examination were at times positive even when the Wassermann reaction was negative.

When the tonsil was reddened and swollen, spirochetes could at times be demonstrated in the scrapings from the surface of the tonsil, even though the inflammation was not specific.

J. W. BRENNAN, Chicago. [ARCH. DERMAT. & SYPH.]

Nose

CHRONIC PYOGENIC INFLAMMATION OF THE ANTRUM AND OTHER ACCESSORY SINUSES: SOME CLINICAL MANIFESTATIONS OF ITS PATHOLOGY. H. TILLEY, J. Laryng. & Otol. **50**:1 (Jan.) 1935.

Tilley attempts to correlate the clinical manifestations of an inflamed sinus with the underlying pathologic changes. Since a clear conception of the normal structure and function of the involved tissues is required, he makes brief reference to some of the fundamental anatomic features and physiologic attributes of the nasal accessory sinuses or air cells. He shows that the mucous membrane of an accessory sinus has three defensive agents: (1) the thin film of mucus which enmeshes such invaders as atmospheric dust, micro-organisms and so on; (2) the cilia of the epithelium which tirelessly lash the mucus toward and through the ostium into the nasal cavity, where the same mechanism drives the secretion into the nasopharynx, whence it passes into the stomach, and (3) secretions which find their way to the surface from the glandular nodules and other cells of the stroma. In discussing the transmission of infection he points out that when pyogenic infection has become established in the mucous membrane of an accessory nasal sinus its intrinsic or immediately local signs and symptoms may be accompanied or even overshadowed by evidences of transmission of organisms and/or their toxins to near or remote regions. Furthermore, the clinical manifestations of such dissemination will be determined largely by which of two channels the infective agents reached their destination, whether by "surface transmission," which implies the progressive involvement of tissues in immediate and direct anatomic continuity with those of the already infected mucoperiosteum of the sinus, or by "vascular convection." The latter term seems to be more correct than "blood borne" because it includes the lymph vessels. Tilley further discusses acute antral inflammation of dental origin, intranasal infection of the antrum, chronic antral catarrh and chronic antral suppuration. About the latter he says that it may be the final phase of an acute dental or of an intranasal infection. The failure of the mucoperiosteal membrane to return to its normal condition may be due to the virulence of the invading organisms or to local conditions that prevent the free escape of inflammatory

secretions from the sinus, e. g., intra-antral or middle meatal edema of the soft tissues in the neighborhood of the ostium or pressure of a middle turbinate against the outer wall of the middle meatus. The presence of any constitutional disease such as syphilis, tuberculosis, diabetes, renal disorder, a grave type of anemia or endocrine deficiencies will prove a severe handicap to the natural subsidence of any type of sinusitis. When chronic pyogenic infection has become established in any of the nasal air cells, histopathologic study of their mucoperiosteum will frequently reveal that the morbid changes are not always uniformly spread throughout the structure but rather tend to be accentuated in one or more of its constituent elements. On this basis, pathologists recognize different types: edematous, infiltrative, fibrotic and cystic. To these Tilley adds another and shows that it may be endowed with more serious possibilities than any of those just mentioned. He refers to the cases in which infection, having implicated the periosteum, has passed by vascular channels into the bone tissues of the sinus capsule. After describing the clinical manifestations of the various types, he discusses infective osteitis. In the last part of his lecture he endeavors to answer the question "Why are well executed operations for chronic pyogenic sinusitis not infrequently followed by a recurrence of symptoms?" He shows that the continuation or the recurrence of symptoms after operative treatment of chronic pyogenic sinusitis is due to a residual infection in the bone tissues of the sinus capsule, and that this is one of the most potent foci for the vascular transmission of septic organisms and their toxins. He stresses that if in removing a pyogenic membrane from a nasal accessory sinus pus is seen beneath the periosteum, even if only in pinpoint collections, the adjoining bone should be uncapped and if it is found to be infected bone should be removed until healthy osseous tissue is reached. If no such evidences of subperiosteal osteitis are detected during the primary operation and there is recurrence of symptoms, infection of the bone should be inferred and prompt measures taken to remove it, because nasal washes, local applications, autogenous vaccines, and inadequate and meddlesome intervention will be of little avail.

EDITOR'S ABSTRACT.

RECURRING PTOSIS. E. WOLFF, Ann. d'ocul. **171**:450 (May) 1934.

Wolff describes a case in which ptosis affecting the same eye recurred four times and disappeared without treatment. Later, a cavernous lymphangioma was found near the orbital border. He believes that attacks of inflammation or an intracystic hemorrhage was the cause of the variations in the volume of the tumor which clinically resembled recurring ptosis. These attacks were accompanied by pain, vomiting and elevation in temperature. He suggests the association of this particular syndrome with cavernous lymphangioma. Juler stated that this syndrome in the absence of a tumor should primarily suggest ethmoiditis.

BERENS, New York. [ARCH. NEUROL. & PSYCHIAT.]

OPTIC NEURITIS ASSOCIATED WITH ACUTE SINUSITIS. N. P. R. GALLOWAY, Ann. d'ocul. **171**:456 (May) 1934.

Galloway reports a case of suppurative ethmoiditis with a large cervical abscess accompanied by bilateral optic neuritis and retinal exudates.

BERENS, New York. [ARCH. NEUROL. & PSYCHIAT.]

EXOPHTHALMOS WITH UNILATERAL PREDOMINANCE IN A PATIENT WITH EXOPHTHALMIC GOITER AND NASOPHARYNGEAL TUMOR. H. ROGER, N. CARREGA and M. AUDIER, Rev. d'oto-neuro-opht. **12**:184 (March) 1934.

A patient, aged 39, suffering from goiter, presented a marked predominance of exophthalmos in the right eye associated with a polyp in the right nostril. The question arose as to whether the nasal condition was the cause of the more marked exophthalmos on the same side. The diagnosis of a malignant growth was ruled out on account of the age of the patient, the duration of the process and the

reducibility of the exophthalmos. The suggestion is offered that the pathogenesis in this case is a reflex mechanism from irritation of the sympathetic nasal filaments in a subject whose sympathetic nervous system was already sensitized by the presence of exophthalmic goiter. Special attention is drawn to the success of the administration of acetylcholine and yohimbine in controlling the cardiovascular phenomena. Villaret and Besançon have shown that yohimbine acts particularly on the cervical sympathetic nervous system. The addition of acetylcholine adds a hypotensive action to the effect.

DENNIS, San Diego, Calif. [ARCH. NEUROL. & PSYCHIAT.]

THE CURE OF OZENA BY SUPPRESSION OF THE NASAL RESPIRATION. D. I. VASILIU and CRISEOTA, Rev. d'oto-neuro-opht. **12**:276 (April) 1934.

A patient, aged 24, who had suffered from ozena since infancy, complained of embarrassed respiration from papillomatosis of the larynx, and a tracheotomy was performed. In spite of the fact that no treatment of the nose was undertaken, the ozena disappeared, and the patient remained free from symptoms for eight months. Ten other patients with typical ozena were treated by occlusion of one nostril. After forty-eight hours the nasal plug was removed; the occluded side was found to be free from crusts, while in the other side the crusts were as abundant as ever. Owing to irritation from the occluding plugs, it was not feasible to keep them in place longer than forty-eight hours. The crusting soon recurred.

DENNIS, San Diego, Calif. [ARCH. NEUROL. & PSYCHIAT.]

DIAGNOSTIC SIGNIFICANCE OF MUCK'S EPINEPHRINE-SOUND EXPERIMENTS. ERNST E. GIERLICHS, Monatschr. f. Kinderh. **59**:321, 1934.

In 1922, Muck described a test on adults which Gierlichs attempted in children. The technic is as follows: A 1:1,000 solution of epinephrine is sprayed into the nose. This is repeated until the normal pale red mucosa becomes silver gray. Then the sound is introduced and is passed over the mucosa two or three times, an effort being made to keep it in the same track. In normal persons the site of the application of the sound reddens, an area of vasodilatation appearing in the center of the generalized vasoconstriction.

Among seventy-five apparently normal school children the reaction was normal in all but nine. More detailed examination showed that of these nine four suffered from syphilis, three from migraine, one from umbilical colic and one from an undetermined condition. The reaction was not positive in children who suffered from spasmophilia in infancy. Gierlichs concludes that the test is of value in distinguishing the group of children with abnormal vasomotor reactions. An incidental conclusion is that certain forms of umbilical colic, when not due to appendicitis, belong to the vasomotor group. GERSTLEY, Chicago. [AM. J. DIS. CHILD.]

SURGICAL INTERVENTION ON THE FRONTAL SINUS. T. VON BAJKAY, Monatschr. f. Ohrenh. **68**:1341 (Nov.) 1934.

Von Bajkay describes the technic employed for operations on the frontal sinus at the rhinolaryngologic clinic of the University of Budapest and reports the results that have been obtained. He also describes a peculiar case of deep cerebral abscess following suppuration of the frontal sinus and a rare case of suppuration of a partitioned frontal sinus of one side. EDITOR'S ABSTRACT.

Miscellaneous

A CURIOUS FORM OF COCAINE POISONING. F. J. COLLET, Rev. d'oto-neuro-opht. **12**:281 (April) 1934.

A girl, aged 7 years, manifestly degenerated (difficulties of speech, strabismus and facial asymmetry), following the packing of the nose with 10 per cent solu-

tion of cocaine exhibited atypical signs of poisoning. There was no pallor or weakness of the heart, though the pulse rate was 150 per minute. The child did not speak and did not fight the nurse but exhibited automatic movements of suction, mastication and dancing or marching round and round. Collet suggests that the effect of the cocaine was to bring about relative inhibition of the cortex, which accounts for the mutism and the predominance of the action of the optostriate body, which presides over the elementary movements for self-preservation: suction and mastication. DENNIS, San Diego, Calif. [ARCH. NEUROL & PSYCHIAT.]

BLOOD TRANSFUSION IN OTORHINOLARYNGOLOGY. U. SECONDI, Arch. ital. di otol. **47**:221 (April) 1935.

Secondi reviews the history of blood transfusion and blood grouping. He discusses the coagulating and bactericidal effect of the transfused blood. The new blood does not act only as a substitute; it repairs circulatory deficiencies, stimulates hematopoiesis, increases oxygen absorption by centers and tissues in general, activates metabolism and the elimination of toxic substances and acts directly as a nutritive medium. It also possesses large amounts of opsonins and complements. The incidents of transfusion are contaminations, malaria, shock and posttransfusional nephropathies. Transfusions were successful when administered for nasal hemorrhages, for infectious diseases and for anemia in convalescent patients. Immunotransfusions were found a valuable aid in the treatment of infectious diseases and in the speeding up of convalescence. Good therapeutic results have been obtained by others in the transfusion of animal blood to man. Secondi advocates further experimentation in this field. He disapproves of the recent Russian experiments in transfusion of blood from cadavers to man.

EDITOR'S ABSTRACT.

TREATMENT OF LESIONS OF THE ESOPHAGEAL WALL AND OF THEIR COMPLICATIONS. J. ALPIN, Monatschr. f. Ohrenh. **68**:1172 (Oct.) 1934.

Alpin's paper is concerned with esophageal lesions and their sequelae which are caused by foreign bodies or by esophagoscopy and which require surgical intervention. On the basis of observations made by himself and by those in other laryngosurgical clinics he reaches the following conclusions: 1. It is necessary to differentiate between diagnostic and therapeutic esophagoscopy. There are practically no contraindications to therapeutic esophagoscopy for the removal of incarcerated foreign bodies. 2. Endoscopic extraction of foreign bodies is indicated even in cases in which there is inflammation of the esophageal wall. 3. The percentage of cases in which endoscopic extraction fails is small according to reports of recent years (from 1.65 to 4 per cent). 4. The mortality in cases of extraction by means of esophagotomia externa is comparatively high (13.4 per cent), even according to recent statistics. Twenty years ago the mortality in cases of endoscopic extraction was only 7.8 per cent and today it has been reduced to 1 or 2 per cent. The author himself observed one fatality in sixty cases of endoscopic extraction. 5. The percentage of severe injuries from esophagoscopy is likewise low. 6. The extraction of foreign bodies by means of external esophagotomy should be restricted to cases in which esophagoscopic extraction has failed and to cases in which there is esophageal rupture and in which the foreign body can be removed through the rupture simultaneously with cervical mediastinotomy, which under these conditions is preliminary to esophagotomy. 7. Abscesses of the esophageal wall require early endoscopic opening. 8. The early symptoms of esophageal perforation (in the absence of a foreign body) require an expectant attitude, since spontaneous cure is effected in some instances. Only if the manifestations of inflammation increase is cervical mediastinotomy advisable. 9. The early signs of esophageal perforation (in the presence of a foreign body) indicate the necessity for endoscopic extraction followed by the treatment that is mentioned under point 8. 10. Foreign bodies that penetrate into the periesophageal space and cause periesophageal abscesses and phlegmons as well as upper mediastinitis

require early cervical mediastinotomy. 11. Foreign bodies that cannot be removed by esophagoscopic extraction and fine and pointed foreign bodies (needles and fish bones) that have pierced the wall require a preliminary preventive lateral tracheotomy. If extraction is not successful, esophagotomy is necessary. 12. Laryngologic surgeons should master the technic of all types of external esophageal operation so as to be prepared for any emergency.

EDITOR'S ABSTRACT.

NATURE OF STUTTERING. A. VON SARBÓ, Monatschr. f. Ohrenh. **68**:1374 (Nov.) 1934.

Von Sarbó explains the development of stuttering on an emotional basis. He shows that the interbrain and midbrain in connection with the extrapyramidal tracts explain the symptoms of stuttering completely. In the last analysis, speaking is an expression of the existing state of mind. The psychic components enter later, but, acting by way of the emotional status, they may make it difficult for the organs of speech to function smoothly. The structural conditions of the region, which harbors also the highest vasomotor center, determines whether or not a person is predisposed to stuttering. The author believes that further research will bring anatomic proof of a predisposition to stuttering.

EDITOR'S ABSTRACT.

RELATIONSHIP BETWEEN STUTTERING AND PARAPHRASIA (TACHYLALIC). H. FREUND, Monatschr. f. Ohrenh. **68**: 1446 (Dec.) 1934.

After citing reports from the earlier literature in which it was maintained that the overhasty speech movements in cases of paraphrasia may develop into stuttering, Freund shows that the same underlying causes may give rise to paraphrasic disorders of speech or to stuttering. He further shows that in spite of the close relationship between the two disorders there also exist certain contradictions, which he lists in opposite columns of a table. He also cites and analyzes a number of case reports. In summarizing his observations on the relationship between stuttering and paraphrasia he states that there is a paraphrasic form of stuttering which has all the aspects of paraphrasia and in which the diagnostic and the therapeutic differentiation are of no significance. Almost the same can be said about "initial" and "rudimentary" stuttering. In spite of characteristic symptoms of stuttering, such as phonophobia, logophobia, a feeling of phonetic incompetence, fear of difficult words and internal stuttering, the basis of the tachylalic paraphrasia is essentially paraphrasic. Stuttering is a superimposed disorder which develops inductively from the conditions that obtain in tachylalic paraphrasia, and stuttering disappears with the appearance of tachylalic paraphrasia. The paraphrasic foundation facilitates therapeutic modification. The logopedic therapy of this form of stuttering is identical with that which is employed in tachylalic paraphrasia and counteracts the symptoms of stuttering. The author gained the impression that the disorder is especially frequent during puberty. In persons with a number of nervous and neurotic symptoms the disorder is especially likely to develop.

EDITOR'S ABSTRACT.

Society Transactions

MASSACHUSETTS EYE AND EAR INFIRMARY

EDITED BY PHILIP E. MELTZER, M.D.

Regular Weekly Clinical Meetings, Otolaryngological Services of Harris P. Mosher, M.D.; E. Herman, M.D.; G. Poirier, M.D., and H. Tobey, M.D., December 1934 and January and February 1935

TWO CASES OF BRONCHIAL OBSTRUCTION. DR. H. G. TOBEY and DR. F. J. POLLOCK.

This 41 year old white woman was admitted to the Massachusetts General Hospital with a diagnosis of pleural effusion. She had had four previous attacks of pleurisy; the first was followed by pneumonia. Her present illness consisted of fever of three weeks' duration, pain in the posterior part of the left side of the chest and cough. The chest was tapped and found dry. An x-ray film showed collapse of the entire left lung. The men in the medical service thought that this condition was on a basis of tuberculosis. Bronchoscopic examination showed that the trachea was over to the left so that the bronchoscope pointed to that side. There was a pale mass in the left bronchus, just below the carina, attached to the inferior medial portion. This was removed, and the bronchus was found to be completely obstructed by a mass. Two more pieces were removed and a small airway created.

The next case is that of a 29 year old man whose chief complaint was of weakness for six months. His own doctor made a diagnosis of tuberculosis and advised that he be cared for in a sanatorium. The man continued to work. Dyspnea developed on exertion, with slight cough and a small amount of green sputum. He arrived at the emergency ward with mild delirium tremens. The sputum (one specimen) was negative for acid-fast organisms. An x-ray film showed collapse of the left lung. On bronchoscopy the carina was found to be pulled over to the left by a scar of heavy fibrous tissue, leaving a 4 mm. lumen, which seemed to be contracted further in a funnel-shaped manner. A smear from the bronchus was negative for tubercle bacilli.

DISCUSSION

DR. L. H. HEINE: This slide illustrates the first case presented. Those of you who heard Dr. E. D. Churchill last Thursday night remember that he mentioned a pulmonary adenoma which came into the bronchus of the lung and which was benign although it killed the patient. We have heard Dr. D. C. Smyth mention the same type of tumor. The slide shows a tendency toward glandular formation. It looks as though it might try to become glandular tissue. The cells correspond in type to epithelial cells, but there is a tendency toward glandular formation in places.

DR. H. G. TOBEY: We had an interesting morning in the bronchoscopy clinic. These two cases were of great interest on the ward over at the Massachusetts General Hospital because, as Dr. King will tell you, both were perfectly typical of tuberculosis. There was a good deal of discussion of the cases over there. Dr. King has been kind enough to come over and tell us their difficulties and what bronchoscopy has done to help out.

DR. DONALD KING: We have had quite a number of these cases of complete collapse of one lung that may be tuberculous, and I think physicians do not realize

that tuberculosis of a bronchus is a fairly common complication. A good many of the tuberculous patients who show complete collapse show marked narrowing or occlusion of a bronchus. We have had only two patients of this type with syphilis; they carried bronchial lesions which cleared quite a little with antisyphilitic treatment. We now have seven or eight patients with benign adenoma who have complete occlusion and one or two who have complete collapse with carcinoma. The differential diagnosis is usually tuberculosis, syphilis, benign tumor or malignant tumor. One reason why we thought this man did not have tuberculosis is that the other lung is in perfect condition, a reason which, of course, does not always hold.

The man who happens to have tuberculosis also shows a perfectly clear lung on the other side, and it was interesting to find that one of these patients apparently had tuberculosis and one an adenoma. The interesting thing is about the occlusion. After three years there is still no evidence of scars above the occlusion.

A Case of Carcinoma of the Nose and Sinuses. Dr. H. G. Tobey and Dr. F. J. Pollock.

This patient, aged 72, has had constant blockage of the left side of the nose for one year. He has had nosebleed from that side for from eight to ten months, occurring two or three times weekly and lasting for an hour, with no other symptoms.

On examination the left side of the nose was completely filled with a mass that apparently extended all the way to the nasopharynx. The teeth were poor.

DISCUSSION

Dr. A. S. MacMillan: The x-ray film shows this mass in the nose and ethmoid region and shows a very narrow antrum between the outer wall and the antronasal wall. The growth then extends backward so that it completely fills the nasopharynx itself.

Dr. F. J. Pollock: The Hinton test is negative. A biopsy was made a week ago. The patient had poor teeth, and the upper ones were extracted.

Dr. H. G. Tobey: The growth seemed to be confined to the bony box of the antrum and ethmoid and did not extend into the soft tissues anywhere; I am quite sure I did not see any of the growth in the nasopharynx, and that is why he looked favorable for operation, but Dr. MacMillan says that it extends back into the nasopharynx.

Dr. F. J. Pollock: When he came for examination the carcinoma was bleeding, and apparently there was a mass extending up as far as the choana. It did not fill the whole nasopharynx.

Dr. J. Lentine: The report on the slide is that it shows a benign polyp or a precancerous lesion with invasion into the central part of the tissue.

Dr. H. G. Tobey: That specimen is probably from the outer edge of the growth. The case seems to be one favorable for operation in spite of the age of the patient, and the malignant tissue seems to be confined to the bony box. There has been no invasion of the soft tissues. The next thing to do is to examine the nasopharynx. He has no palpable glands.

Dr. M. G. Evans: How do you plan to approach that at operation?

Dr. H. G. Tobey: Through a Moure incision we shall remove all that can be removed and clean the rest up with radium. I think this should be done under general anesthesia, as it is doubtful that the ethmoidal region could be anesthetized with a local anesthetic. Dr. Mysel, would you do it under local anesthesia?

Dr. P. Mysel: At 72 I think I should.

Dr. C. H. Allman: You might use avertin and block anesthesia.

Dr. H. G. Tobey: That is a good suggestion.

A Case of Fibrosarcoma of the Ethmoid. Dr. G. H. Poirier and Dr. J. R. Richardson.

This case was observed in a 39 year old woman who came from Canada on Dec. 26, 1934. She had had a discharge from the left side of the nose for eight months. For five months she had had frequent headaches radiating through the vertex. For five months also, she had had complete obstruction on the left side of the nose. Five weeks before entry into the hospital she had a radical operation on the antrum at the Prince Edward Island Hospital. Pus and thickened membrane were found. There was no unusual tissue in the antrum, but a specimen of some suspicious tissue in the nose was taken for biopsy. The patient lost 10 pounds (4.5 Kg.). There is no history of malignant growths in the family.

On entry she showed in the left side of the nose copious gelatinous secretion from the left antrum. This mass bled easily on examination. A biopsy was made on this, and x-ray films were also taken.

DISCUSSION

Dr. L. H. Heine: The biopsy specimen was shown two weeks ago. It disclosed a typical sarcoma with many closely packed spindle-shaped cells and many small thin-walled blood vessels. The biopsy done at Halifax resulted in a diagnosis of angiosarcoma, but from the closely packed cells which may be seen with no definite arrangement we must consider it a fibrosarcoma.

Dr. J. R. Richardson: The x-ray film taken on hospitalization shows the left antral lining thickened, but there is no evidence of destruction about the antrum, so the antral condition is probably secondary to something else, and you see this large mass in the ethmoid region with complete destruction of the ethmoid cells and a large mass in the nose.

Dr. G. H. Poirier: It is rather unusual to see a malignant tumor of the sinuses at as early a stage as this. The operation which was done nine days ago made use of a combination of the intranasal, external and transantral routes; that is, an external incision was made, a bony opening effected, and the superior limits of the mass seen. The antrum had already been treated by a radical operation. That was reopened through the canine fossa, the whole of the naso-antral wall was taken down, and the posterior two thirds of the inferior turbinate was taken out. That gave us a straight approach to the mass. It was removed with a snare and a punch forceps. She had 2,000 millicurie hours of radium treatment with platinum needles. We feel that we have it all. Now, at the end of six or seven days, the question is whether she should have roentgen treatment or not.

Dr. E. W. Herman: In a sarcoma especially radiosensitive as in this case the amount of radium put in is that estimated to handle effectively any fragments left in the operative field. Now as to the question of treatment with the x-rays—there seems to be a little ambiguity about that. Roughly, there are four uses for the x-rays: as a surgical procedure; in conjunction with radium; alone in the case in which this is found sufficient, and, finally, as a simple palliative. In this case the mass was presumably removed surgically and the treatment with radium was simply to handle what might inadvertently have been left in the operative field. So the roentgenologists will not want to use the x-rays in this case unless there is definite evidence of recurrence, or unless the surgeon feels that the tumor has not been completely removed. There are certain cases in which you feel you can cover the whole area thoroughly with radium, and other cases in which you feel it is unsafe to give the total dose of radium required and you like to combine it with the x-rays. Then there are cases in which you do not plan to do anything but slow up that growth, as when there is pain, by relieving pressure.

Dr. H. P. Mosher: How soon would you expect a return in this case if she is going to have it? How long should we keep her in the hospital?

Dr. E. W. Herman: Six months or a year for demonstrable recurrence. Send her home and have her report in three months for observation.

DR. C. T. PORTER: If one of us had this condition, would not he feel better if after operation and after treatment with radium he had a full dose of the x-rays? What is the objection?

DR. E. W. HERMAN: A full dose of curative x-rays in sarcoma has with it some very real dangers, that is, a really extensive dose. It causes an enormous amount of bone necrosis and sloughing.

DR. L. A. SCHALL: Sarcoma is a terrible disease, and one ought to handle it with every agency one can command. I should put her through a curative dose of the x-rays now, even with bone necrosis. I had a patient who had an abdominal metastasis after a year which I felt should have a curative dose postoperatively. It had been advised, but the x-ray department refused to give it. The patient came back to the hospital with a recurrence in the lower part of the scar. I feel that one should give massive doses for cure.

DR. E. W. HERMAN: I have seen patients who have had so much treatment with the x-rays—all ending in no good. Sarcomas are bad.

A CASE OF CHRONIC SUPPURATIVE OTITIS MEDIA, EXTRADURAL ABSCESS AND PETROSITIS. DR. H. G. TOBEY and DR. B. E. LOVESEY.

A man, aged 21, entered the infirmary on Dec. 5, 1934, complaining of pain in the right ear. About ten years prior to this he had scarlet fever complicated with bilateral otitis media, and a simple right mastoidectomy was done at the Homeopathic Hospital. Following that the right ear discharged almost continuously.

Four days before admission, after he had cleaned the canal with a match and some cotton, pain began, which increased in severity. On the day of entrance he had headache and dizziness but no nystagmus, no falling, no nausea and no vomiting. The hearing test showed that he could not hear a whisper or conversation with either ear. The Weber test showed the right side involved.

The day after entrance a postaural abscess on the right side was incised and drained. The discharge was profuse and foul, and cultures revealed Staphylococcus aureus. The white blood cell count was 15,700; the hemoglobin content was 95 per cent; the pulse rate was 78, and the respiratory rate 21. The urine was normal. X-ray films showed a postoperative condition of the right mastoid and enlargement of the left mastoid antrum.

For about two weeks the discharge persisted. The canal wall was thickened and edematous, and the middle ear could not be observed. Headache was persistent. The visual fields and fundi were normal. The temperature was practically normal. A neurologic examination made just before operation gave the impression of a lateral sinus thrombosis or of an abscess.

On December 22 Drs. Tobey, Meltzer and Ireland performed a radical mastoidectomy and drainage of an extradural abscess on the right side. The old incision was reopened, the lateral sinus was found to be exposed, and also there was exposed dura in the region of the tegmen. In investigating the exposed dura a large sequestrum was observed. The dura was covered with necrotic granulations but was not bulging. A large decompression was done. The solid angle was soft and was curetted out so that all the semicircular canals could be identified.

Four days after operation, on December 27, partial paralysis of the right side of the face was noticed, not accompanied by nausea, vomiting or nystagmus. On December 31 the patient complained of severe headache on the right side; there was no stiffness of the neck, the eyegrounds were normal, but the hearing test gave indications that the labyrinth was dead. A lumbar puncture done on Jan. 1, 1935, showed an initial pressure of 300 with a final pressure of 120. The cell count was 250, with polymorphonuclears 45 and lymphocytes 55 per cent. The sugar was reduced, and the test for globulin was slightly positive. The fluid was clear.

The next day a revision of the radical right mastoidectomy was done. The lateral sinus was exposed and the cerebellar dura uncovered. The solid angle of bone between the dura of the middle fossa and the cerebellum was removed to a point where all the semicircular canals could be seen. A loose fragment of

bone about 0.5 cm. in all diameters was removed from the region just anterior to the superior semicircular canal and found to be covered with granulations.

In the process of removing the bone of the superior angle the superior semicircular canal was included, and there was an escape of clear cerebrospinal fluid under presure. It appeared that the internal auditory canal had been exposed when the bony superior semicircular canal was connected with the space left on the removal of the sequestrum.

We then made the operative diagnosis of petrositis, extradural abscess and perisinus infection with granulations.

An early visit to the ward the next morning found the patient free from headache and reading a newspaper, with no increase in the amount of facial paresis. The progress has been uneventful.

It is now seven days since the operation, and the patient is free from symptoms. The headache is absent. The temperature rose immediately following the operation, but the next day and up to two days ago the temperature was normal. About forty-eight hours ago the temperature rose, and examination revealed a peritonsillar infiltration and cervical adenitis. Irrigations with hot dextrose solution gave relief, and the patient is now anxious to be up and about.

DISCUSSION

Dr. A. S. MacMillan: The interesting part of this x-ray film of the right side is the region about the superior semicircular canal. Three weeks before the last operation it was perfectly clear, and then in the same area on the day before the operation you see very definite destruction of the semicircular canal, at this point. The area of destruction is marked in comparison with that one.

Dr. H. P. Mosher. Why did your patient with petrositis whose case was reported last time have orbital pain?

Dr. H. G. Tobey: This man may have had orbital pain. It was hard to make him understand. For all we know he did have some orbital pain.

Dr. P. E. Meltzer: We have not said a great deal about labyrinthitis in this youth. I have a feeling that in spite of the symptoms we cannot exclude entirely the extension of the infection from the labyrinth into the region of the internal auditory meatus.

(Further report on Jan. 23, 1935: On January 21, Dr. Meltzer closed the flaps. It is now twenty days since the operation. The patient has been practically free from symptoms. The headache has disappeared. The temperature rose once directly after the operation and a second time shortly afterward. Examination revealed a peritonsillar infiltration and cervical adenitis. Irrigations with hot dextrose solution afforded relief, and the patient has been up and about.)

A Case of Petrositis. Dr. H. G. Tobey and Dr. B. E. Lovesey.

A 41 year old man entered the hospital on Nov. 27, 1934, with a diagnosis of suppurative acute otitis media and acute mastoiditis on the right side. The hearing test, with use of the noise apparatus, showed the hearing impaired in both ears. X-ray films showed the left mastoid normal and the right with complete destruction at the tip.

On December 1 a simple right mastoidectomy was done under ether by Drs. Knowlton and Ireland. Pus under pressure was found in a large cavity near the tip. From this there was a lead to the deep muscles in the neck. The sinus was covered with granulations. The convalescence was uneventful and the patient was discharged on December 11.

Following his discharge the patient had severe frontal and bilateral temporal pain each night, which was unrelieved by sedatives. On December 19 the postaural wound became swollen, and when it was incised pus escaped. At no time was there vertigo, nausea, vomiting or fainting.

He reentered the hospital on December 21. The white blood cell count was 7,000; the pulse rate, 63; the respiratory rate, 37, the hemoglobin content, 95 per cent. The Wassermann reaction was negative. Local examination showed no facial paralysis, no paresis of the sixth nerve and no anesthesia of the face. Five days after admission the patient became drowsy and had severe pain on the right side of the head and about the eyes. Neurologic examination before operation revealed nothing. The eye specialist consulted reported the fundi within normal limits and the visual fields normal. A lumbar puncture gave an initial pressure of 350. The cell count showed 6 cells. The roentgenologist reported that the sinuses were normal, that both petrous pyramids were large and pneumatic, and that there were cells remaining on the right side and a decalcification in the tip.

A radical right mastoidectomy was done. The dura was exposed over the whole of the mastoid tegmen and well over the middle ear. It was thick and fibrous but not bulging. The solid angle was opened backward to expose the superior semicircular canal, but no soft bone or pus lead was found. That evening the patient was irrational. He could move the lower part of his face, but the right upper eyelid showed marked ptosis. There was no exophthalmos, nystagmus or vomiting. Later, following operation, examination of the eye showed palsy of the right third nerve, which was incomplete.

DISCUSSION

DR. H. P. MOSHER: What was the interval between the first and the second attack?

DR. B. E. LOVESEY: About three weeks.

DR. H. P. MOSHER: Did you find soft bone?

DR. H. G. TOBEY: Yes. He had ptosis of the right upper eyelid before the second operation. The morning of the operation he had severe occipital pain, so we thought meningitis was starting, but we had decided in favor of the operation before that came on. We took off the soft bone which we found over the roof as well as the entire roof of the mastoid antrum, the aditus and the bone well forward, exposing the eustachian orifice so that we could have gone through Kopetzky's point if necessary. But in following this bone forward, just over in front of the superior semicircular canal, we came on this definitely softened bone, and putting in a small curet we took out some granulation tissue.

DR. A. S. MACMILLAN: He came for examination after the process had gone on for a month, and an x-ray film seemed to show rather definite destruction on the right side. At the same time x-ray films of the petrous pyramids were taken which showed a questionable area at the apex. A subsequent film taken some time later showed that there was not the change one would expect, so that the film taken first did not show destruction in the petrous pyramid. However, the film taken from the base showed the apex pretty well decalcified.

DR. L. H. HEINE: The stained section shows necrotic bone, denoted by the enlarged lacunae and roughened bone margins. There is some fibrotic tissue infiltrated with lymphocytes and leukocytes. Hemorrhage is also noted, with deposits of hemosiderin. The process is probably very early repair.

DR. H. G. TOBEY: These two cases fulfil most of the criteria of petrositis, with practically typical pain in both cases followed by operation and finding of the infected area.

DR. H. P. MOSHER: In the second case the question was whether to use the approach of Kopetzky or to use a more natural approach, that is, to follow along the roof of the base of the pyramid external to the superior semicircular canal and see what one might find. Dr. Tobey found soft bone. Then the question came up whether it was infected bone, and the consulting pathologist said he would not commit himself. However, one encounters infection in the region of the ear and one can honestly claim that there is infection in the petrous bone by

doing a partial external operation on the bone and looking, if in any of these cases one has the courage to do a partial operation. This is the first time we have had a specimen of this kind.

PROGRESS IN A CASE OF PETROSITIS. DR. H. G. TOBEY and DR. B. E. LOVESEY.

A girl aged 15 entered the infirmary on Dec. 10, 1934, with a discharge from the left ear, which she had had for four weeks following a cold and sore throat. For a weeek previous to admission there was occasional pain in the left mastoid region with some tenderness and swelling. Headaches were occasional; she had no chills, fever, vertigo, nausea or vomiting, and she had no previous history of ear trouble.

On December 12 a simple left mastoidectomy was done and the lateral sinus exposed throughout its length. It was found to be covered with thick granulations, which were not removed. The zygomatic area was found to be extensive. The convalescence was uneventful, and the patient was discharged with mild nasopharyngitis.

On the second day at home she complained of slight headache and slept little. The third day she had pain behind the left eye, which seemed to extend over the upper jaw on the left side, and her teeth ached.

On admission she had the dental pain, headache on the left side, some orbital pain, no nausea or vomiting, no dizziness, no nystagmus, no facial paralysis, no stiffness of the neck and no diplopia. The middle ear was dry; there was no postaural tenderness or swelling, but at the bottom of the incision there was a small fistula discharging a serosanguineous fluid. The Weber test showed a hearing defect lateralized to the affected side. The white blood cell count was 11,100; the pulse rate, 62; the respiratory rate, 38; the hemoglobin content, 90 per cent; the urine was normal.

Two medical consultants did not reveal any positive medical findings. Dental consultants reported the teeth to be normal. Daily examinations of the eyes revealed the fundi normal and the disks within normal limits, although on two occasions there was some blurring.

On Jan. 6, 1935, there was some stiffness of the neck with pain in the occipital region. Kernig's signs were sluggish. Neurologic examination a few hours later gave essentially normal findings. Many blood counts were done, and they ranged from 9,000 to 11,000. The temperature was irregular. An x-ray film showed definite destruction in the left petrous apex.

For two days after the foregoing report there was no change in symptoms. Then on January 12, at 2:30 a. m., the patient awoke and complained of being cold, especially in the feet and back. The temperature was 102 F. At 3:45 the temperature was 103 F. The patient was nauseated and vomited a greenish-yellow fluid. She had no headache. The back of her neck ached. At 8 a. m. the temperature was 100.4 F.

A lumbar puncture was done and 2,050 cells found; the Pandy test was positive; there was an insufficient amount of fluid to allow determination of the sugar.

She had no nystagmus; Babinski's sign was positive; the knee jerks were sluggish; Kernig's signs were positive.

Dr. Tobey reopened the mastoidectomy wound on the left side and found it firmly healed; the antrum was located, and the posterior wall of the canal was taken down. A wide exposure of the dura was made anteriorly and posteriorly, and no lead was found through to the petrosal base. The anterior buttress was removed. The dura was retracted and the superior surface of the petrous pyramid brought into view. The great deep petrosal nerve was identified. A curved probe was introduced posteriorly and beyond this nerve, 4.5 cm. from the squamosal plate. On rotating the probe's tip it fell into a cavity, which felt soft and had very definite internal and external bony margins. At no time was pus encountered.

The next day the patient was bright and cheerful. The stiffness of the neck was almost gone. She had no nystagmus, no facial paresis or sixth nerve involvement and no headache.

On January 15, three days after operation, the patient complained of pain in the back and over the left eye. A slight stiffness of the neck was present. A lumbar puncture was done, which showed 650 cells, clear fluid, positive globulin and sugar very slightly reduced.

On January 19, using N-methyl-cyclo-hexanyl-methyl barbituric acid, Drs. Tobey and White removed the packing in the left mastoid cavity. A probe was passed into the cavity, and four x-ray films were taken. The wound was repacked, and the patient was returned to bed in good condition. She has had no symptoms. The fundi have remained normal.

DISCUSSION

DR. H. G. TOBEY: We showed this girl two weeks ago, and the consensus then was to leave her alone, but the following Saturday she started having the meningeal symptoms. At the time of the operation, by elevating the dura on the anterior face of the petrous pyramid we could demonstrate the facial nerve and the great superficial petrosal nerve entering the bone; we went posterior to that and straight in and felt we were in this region (demonstrated by x-ray film). She did perfectly well. We took her to the x-ray room and under N-methyl-cyclo-hexanyl-methyl barbituric acid and some discomfort due to the shortness of the anesthesia, some hurry and more or less bleeding from granulating tissue we attempted to pass this probe.

DR. H. P. MOSHER: Dr. Tobey asked me to come down during the operation. In order to reach the superior surface of the petrous portion of the temporal bone you have to get a large amount of the squama off, and I think I urged Dr. Tobey a little to enlarge the opening he had made. With a small opening the brain will not come up.

DR. H. G. TOBEY: In elevating the brain you can see quite satisfactorily the fifth ganglion and the superficial petrosal nerve coming through the hiatus fallopii and running over the anterior face of the petrous pyramid.

A CASE OF MASTOIDITIS WITH COMPLICATIONS. DR. H. G. TOBEY and DR. B. E. LOVESEY.

This boy, aged 16, entered the infirmary on Dec. 29, 1934. About twelve days previous to admission he had pain in the right ear, and two days later a paracentesis tympani was done and relief obtained. The night before admission he had postaural pain and swelling on the right side. A slight headache was noticed only on one day. There was no vertigo, tinnitus, vomiting or chill; the white blood cell count was 24,900; the hemoglobin content, 95 per cent; the pulse rate, 83; the respiratory rate, 17. The Hinton test was negative.

As a child he had scarlet fever. A tonsillectomy and adenoidectomy were done seven years ago.

On January 5, seven days after admission, the nineteenth day after the onset, a simple right mastoidectomy was done. Large cells were encountered and pus was found. There was no exposure of the dura or of the lateral sinus.

The convalescence was uneventful until nine days later when, after the dressing was changed, vomiting occurred, and the temperature became elevated. In two hours there was some stiffness of the neck, and headache seemed to be increasing.

A lumbar puncture showed 650 cells; the initial pressure was 100 and the final pressure 80. The dynamics were normal. The Pandy test was positive, and there was a very slight reduction of sugar. The knee jerks were less active. Babinski's sign was present, and Kernig's signs were positive. There were no facial paralysis and apparently no involvement of the sixth nerve.

The Weber test was lateralized to the right ear, which did not show much loss in hearing. Dr. Tobey decided to reexamine the mastoid.

On January 14 the mastoidectomy was revised; the granulations were clean and fairly well organized. The antrum was identified, and the dura was exposed

through considerable bone. The sinus was exposed and appeared normal. On exposure of the dura a large, apparently thrombosed blood vessel was seen, which extended well forward over the middle ear. A gush of pus followed curetting of the bone. This pus seemed to come from the bone rather than from between the bone and the dura. The dura over this area seemed to be smooth. A gauze drain was inserted. There has been no facial paralysis.

On January 16, two days later, the lumbar puncture showed 170 cells, with lymphocytes 85 and polymorphonuclears 15 per cent. A smear showed no organisms. The Pandy test was faintly positive, and the test for sugar was positive.

The convalescence has been uneventful.

DISCUSSION

DR. H. G. TOBEY: I wish all outcomes were as satisfactory as this. We were unconsciously on the way to a septic meningitis. Pain was temporal. We got the case early and fortunately found this large thrombosed vessel on the dura, which seemed to fade out and then began to branch and it seemed one of these branches was going into the bone. When the curet came up there was a gush of rather foul thick yellowish pus, but still the dura looked perfectly smooth. So there is no question but that the pus came from an infected area in the bone, and that infection caused the thrombosis of this vessel. The condition would have gone on to septic meningitis. I do not believe we shall have any more trouble. That was in the zygoma far forward and it went far over the middle ear. There was a lot of cells. This area between the roof of the middle ear and immediately behind was quite thick. There were cells there. There was a localized abscess right in there.

DR. C. H. ALLMAN: In doing an ordinary simple mastoid could you have seen those cells?

DR. H. G. TOBEY: Yes. We had done a simple mastoidectomy as we ordinarily would do it in that region. This boy had a tremendously large mastoid. We deliberately waited a week. As a matter of fact, it was not greatly broken down at the time of operation.

DR. H. P. MOSHER: This case interested me very much indeed. Akin, in his book on abscess of the brain, considers as a cause of abscess of the brain a contact with a septic focus, and he divides the cases into two classes; in the first the abscess is perivascular, and in the second (these cases are not so frequent) there is a thrombus also coming from a septic focus. Dr. Cahill should have something to say along that line. This case fits in very strikingly with one of the causes which Dr. Akin mentions.

DR. H. P. CAHILL: I never saw a vessel quite like that one on the dura. It was much larger than the dilated dural vessel one usually sees. As regards the location of the pus I do not quite agree with Dr. Tobey. I feel it was deeper than the zygoma, a little deeper, and that it probably was a subdural abscess rather than one in the zygoma because it seems to me that at that time you had the middle ear well exposed and that you were operating in the middle ear rather than in the zygoma. You came out just inside the antrum, between the roof of the antrum and the location of the anterior portion of the middle ear.

DR. H. P. MOSHER: Would you have incised the vein?

DR. H. P. CAHILL: No, sir. I certainly would not. We often hear of a spectacular gush of pus, but this was one in which we had it.

DR. H. G. TOBEY: In the first place the dura was perfectly smooth and I do not think it was a true extradural abscess. Here was this vessel apparently disappearing, and we had already elevated the dura. There was no pus. I put the curet cup down between the dura and the roof and curetted down that way, and out came the pus. It was a bit internal, but it was in those cells underneath the inner plate.

DR. A. S. MACMILLAN: The x-ray film shows a very cellular petrous bone on the affected side as compared with the petrous bone on the other side. These were taken before operation.

DR. H. G. TOBEY: There seem to be quite a few of these cases of aseptic meningitis. I think they have been investigated early. They might have turned into cases of abscess of the brain or septic meningitis. You remember that in Dr. Meltzer's case cells were also found in the spinal fluid. He treated that patient early, and the patient has done perfectly well. None of the patients had any bacteria in the spinal fluid as far as I know.

Book Reviews

Oto-rhino-laryngologie du médicin practicien. By Dr. Georges Laurens, oto-rhino-laryngologiste de l'hôpital Saint-Joseph. Sixth edition. Paper. Price, 42 francs. Pp. 533, with 587 illustrations. Paris: Masson & Cie, 1934.

As the title suggests, this is a textbook for medical students and physicians engaged in general medical practice. Elementary in character, it is not intended to be of any great interest to physicians, limiting its scope to otorhinolaryngology.

Always realizing the limitation of his audience, Laurens does not allow himself to be removed from the realm of the novitiate. The style is simple and concise but thoroughly didactic. The author assumes nothing, but stresses fundamentals in every particular. His advice regarding equipment is sound and practical. His instruction on technic would well warrant a review by physicians old in the service of otorhinolaryngology. He continually emphasizes basic principles, from the manipulation of the head mirror to the final therapeutic procedure, and supplements this with five hundred and eighty-seven excellent illustrations. He outlines diseases and their management almost epigrammatically, but effectively. He incorporates many conditions not usually discussed in this type of publication, but disregards others, perhaps intentionally, rather than confuse the uninitiated. This work is an excellent text for either the student or the physician engaged in the routine medical pursuits.

News and Comment

ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

The Silver Anniversary of the Academy of Ophthalmology and Otolaryngology will be celebrated in Cincinnati, Sept. 14 to 20, 1935.

Directory of Otolaryngologic Societies *

FOREIGN

COLLEGIUM OTO-RHINO-LARYNGOLOGICUM AMICITIÆ SACRUM

President: Prof. Gunnar Holmgren, Karolinska Mediko Kirurgiska Institut, Stockholm, Sweden.
Secretary: Prof. Dr. C. E. Benjamins, Verlengde Heereweg, 143, Groningen, The Netherlands.

NATIONAL

AMERICAN MEDICAL ASSOCIATION, SCIENTIFIC ASSEMBLY, SECTION ON LARYNGOLOGY, OTOLOGY AND RHINOLOGY

Chairman: Dr. Ralph A. Fenton, 1020 S. W. Taylor St., Portland, Ore.
Secretary: Dr. Gordon B. New, Mayo Clinic, Rochester, Minn.
Place: Kansas City, Mo.: Time: May 11-15, 1936.

AMERICAN ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. Wells P. Eagleton, 15 Lombardy St., Newark, N. J.
President-Elect: Dr. Frank E. Burch; 408 Peter St., St. Paul.
Executive Secretary: Dr. William P. Wherry, 1500 Medical Arts Bldg., Omaha.
Place: Cincinnati. Time: Sept. 14-20, 1935.

AMERICAN BRONCHOSCOPIC SOCIETY

President: Dr. H. M. Taylor, 111 W. Adams St., Jacksonville, Florida.
Secretary: Dr. Lyman Richards, 319 Longwood Ave., Boston.

AMERICAN LARYNGOLOGICAL ASSOCIATION

President: Dr. Dunbar Roy, 113 N. Pryor St., Atlanta, Ga.
Secretary: Dr. W. V. Mullin, 9204 Euclid Ave., Cleveland.

AMERICAN LARYNGOLOGICAL, RHINOLOGICAL AND OTOLOGICAL SOCIETY, INC.

President: Dr. Perry G. Goldsmith, 170 St. George St., Toronto, Canada.
Secretary: Dr. R. L. Loughran, Sharon, Conn.

SECTIONS:

Eastern.—Chairman: Dr. Frederick T. Hill, Professional Bldg., Waterville, Maine.
Southern.—Chairman: Dr. Beverly R. Kennon, Medical Arts Bldg., Norfolk, Va.
Middle.—Chairman: Dr. Daniel W. Layman, Medical Arts Bldg., Indianapolis.
Mid-Western.—Chairman: Dr. Edward H. Cary, Medical Arts Bldg., Dallas, Texas.
Western.—Chairman: Dr. Frank A. Burton, Bank of America Bldg., San Diego, Calif.

AMERICAN OTOLOGICAL SOCIETY

President: Dr. Francis R. Packard, 304 S. 19th St., Philadelphia.
Secretary: Dr. Thomas J. Harris, 104 E. 40th St., New York.

* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.